Modification Form for Permit BIO-UWO-0179

Permit Holder: Ravi Menon

Approved Personnel
(Please stroke out any personnel to be removed)

~~Zheng Wang~~

Martyn Klassen

Sarah Hughes

Additional Personnel
(Please list additional personnel here)

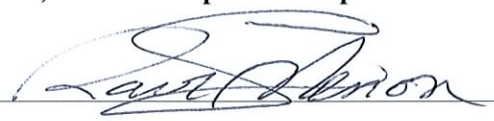
David Rudko

Miranda Bellyou-Camilleri

	Please stroke out any approved Biohazards to be removed below	Write additional Biohazards for approval below. *
Approved Microorganisms	~~Human(established): U87MG~~	Human(established): U87 MG (for injection)
Approved Cells		
Approved Use of Human Source Material		
Approved GMO		
Approved use of Animals	Rhesus macaque ~~Mice~~	Rats (submitted to AUS)
Approved Toxin(s)		

** PLEASE ATTACH A MATERIAL SAFETY DATA SHEET OR EQUIVALENT FOR NEW BIOHAZARDS.*
*** PLEASE ATTACH A BRIEF DESCRIPTION OF THE WORK THAT EXPLAINS THE BIOHAZARDS USED AND HOW THEY WILL BE USED.*

As the principal investigator, I have ensured that all of the personnel named on the form have been trained. I will ensure that this project will follow the Western Biosafety Guidelines and Procedures Manual for Containment Level 1 2 Laboratories (and the Level 3 Facilities Manual for Level 3 projects). I will ensure that UWO faculty, staff and students working in my laboratory have an up-to-date Hazard Communication Form, found at http://www.wph.uwo.ca.

Signature of Permit Holder: 

Classification: 2

Date of Last Biohazardous Agents Registry Form: Oct 2, 2007

Date of Last Modification (if applicable):

BioSafety Officer(s):

Chair, Biohazards Subcommittee:

January 10, 2010

In-Vivo Quantification of CMRO2 in a Rat Model of Glioblastoma Multiforme

1) Male Sprague-Dawley rats will be placed under gas anaesthesia.

2) Rats will be injected with 1x10^5 malignant glioma cells into the forebrain.

3) MRI studies will be performed seven, ten and fourteen days after injection.

4) 70 % isotopically enriched O17 gas will be administered for two minutes during imaging to study the effects of H2O17 tracer and CMRO2 in glioblastoma multiforme.

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Product Description

Before submitting an order you will be asked to read and accept the terms and conditions of ATCC's Material Transfer certain cases, an MTA specified by the depositing institution.
Customers in Europe, Australia, Canada, China, Hong Kong, India, Japan, Korea, Macau, Mexico, New Zealand, Singap R.O.C. must contact a local distributor for pricing information and to place an order for ATCC cultures and products.

Cell Biology

ATCC® Number: HTB-14™ Order this Item **Price:** $256.00

Designations:	U-87 MG
Depositors:	J Ponten
Biosafety Level:	1
Shipped:	frozen
Medium & Serum:	See Propagation
Growth Properties:	adherent
Organism:	*Homo sapiens* (human)
Morphology:	epithelial
	PHOTO
Source:	**Organ:** brain **Tumor Stage:** classified as grade IV as of 2007 **Disease:** glioblastoma; astrocytoma
Permits/Forms:	In addition to the MTA mentioned above, other ATCC and/or regulatory permits may be required for the transfer of this ATCC material. Anyone purchasing ATCC material is ultimately responsible for obtaining the permits. Please click here for information regarding the specific requirements for shipment to your location.
Applications:	transfection host (Nucleofection technology from Lonza Roche FuGENE® Transfection Reagents)
Tumorigenic:	Yes
Antigen Expression:	Blood Type A, Rh+
DNA Profile (STR):	Amelogenin: X CSF1PO: 10,11 D13S317: 8,11 D7S820: 8,9 D5S818: 11,12 D16S539: 12 vWA: 15,17 THO1: 9.3 TPOX: 8

Related Li
NCBI Entrez S
Cell Micrograp
Make a Depos
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Related Cell C

Cytogenetic Analysis:	This is a hypodiploid human cell line with the modal chromosome number of 44 occurring in 48% of cells. The rate of higher ploidy was 5.9%., Twelve markers were common to all cells, including der(1)t(1;3) (p22;q21), der(16)t(1;16) (p22;p12), del(9) (p13) and nine others. The marker der(1) had two copies in most cells. There was only one copy of normal X. N1, N6 and N9 were not found.
Isoenzymes:	AK-1, 1 ES-D, 1 G6PD, B GLO-I, 1 Me-2, 1 PGM1, 2 PGM3, 1
Age:	44 years
Gender:	female
Ethnicity:	Caucasian
Comments:	This is one of a number of cell lines derived from malignant gliomas (see also ATCC HTB-15 and ATCC HTB-16) by J. Ponten and associates from 1966 to 1969. Mycoplasma contamination was eliminated in September 1975.
Propagation:	**ATCC complete growth medium:** The base medium for this cell line is ATCC-formulated Eagle's Minimum Essential Medium, Catalog No. 30-2003. To make the complete growth medium, add the following components to the base medium: fetal bovine serum to a final concentration of 10%. **Atmosphere:** 5% CO2 in air recommended **Temperature:** 37.0°C
Subculturing:	**Subcultivation Ratio:** A subcultivation ratio of 1:2 to 1:5 is recommended **Medium Renewal:** 2 to 3 times per week Remove medium, and rinse with 0.25% trypsin, 0.03% EDTA solution. Remove the solution and add an additional 1 to 2 ml of trypsin-EDTA solution. Allow the flask to sit at room temperature (or at 37C) until the cells detach. Add fresh culture medium, aspirate and dispense into new culture flasks.
Preservation:	Culture medium, 95%; DMSO, 5%
Related Products:	Recommended medium (without the additional supplements or serum described under ATCC Medium):ATCC 30-2003 recommended serum:ATCC 30-2020
References:	22159: Beckman G, et al. G-6-PD and PGM phenotypes of 16 continuous human tumor cell lines. Evidence against cross-contamination and contamination by HeLa cells. Hum. Hered. 21: 238-241, 1971. PubMed: 4332744 22536: Fogh J, et al. Absence of HeLa cell contamination in 169 cell lines derived from human tumors. J. Natl. Cancer Inst. 58: 209-214, 1977. PubMed: 833871 22539: Fogh J, et al. One hundred and twenty-seven cultured human tumor cell lines producing tumors in nude mice. J. Natl. Cancer Inst. 59: 221-226, 1977. PubMed: 327080 23094: Olopade OI, et al. Molecular analysis of deletions of the short arm of chromosome 9 in human gliomas. Cancer Res. 52: 2523-2529, 1992. PubMed: 1568221 23128: Ponten J, Macintyre EH. Long term culture of normal and neoplastic human glia. Acta Pathol. Microbiol. Scand. 74: 465-486, 1968. PubMed: 4313504 32901: Li YM, et al. Molecular identity and cellular distribution of advanced glycation endproduct receptors: relationship of p60 to OST-48 and p90 to 80K-H membrane proteins. Proc. Natl. Acad. Sci. USA 93: 11047-11052, 1996. PubMed: 8855306

While ATCC uses reasonable efforts to include accurate and up-to-date information on this site, ATCC makes no warra representations as to its accuracy. Citations from scientific literature and patents are provided for informational purpo not warrant that such information has been confirmed to be accurate.

All prices are listed in U.S. dollars and are subject to change without notice. A discount off the current list price will b cultures for nonprofit institutions in the United States. Cultures that are ordered as test tubes or flasks will carry an a fee. Fees for permits, shipping, and handling may apply.
Back to my Search

~~BIO-RRI-0036~~
BIO - UWO - 0179

THE UNIVERSITY OF WESTERN ONTARIO
BIOHAZARDOUS AGENTS REGISTRY FORM
Revised Biohazards Subcommittee: January, 2007

This form must be completed by each Principal Investigator holding a grant administered by the University of Western Ontario where the use of biohazardous infectious agents are described in the experimental work proposed. The form must also be completed if animal work is proposed involving the use of biohazardous agents or animal carrying zoonotic agents infectious to humans. Containment Levels will be required in accordance with Laboratory Biosafety Guidelines, 3rd edition, 2004, Health Canada (HC) or Containment Standards for Veterinary Facilities, 1st edition 1996, Canadian Food Inspection Agency (CFIA).

Completed forms are to be returned to Occupational Health and Safety (Stevenson-Lawson Building, Room 60) for forward to the Biohazard Subcommittee. For questions regarding this form, please contact the Biosafety Coordinator at extension 81135. If there are changes to the information on this form (excluding grant title and funding agencies) modifications must be completed and sent to Occupational Health and Safety. See website: www.uwo.ca/humanresources

PRINCIPAL INVESTIGATOR Ravi Menon
SIGNATURE [signature]
DEPARTMENT Imaging
ADDRESS RRI - 1st Floor
PHONE NUMBER X 34148 / 34060
EMAIL rmenon@imaging.robarts.ca

Location of experimental work to be carried out: Building(s) CBH Room(s) CB-30
*For work being performed at Institutions affiliated with the University of Western Ontario, the Safety Officer for the Institution where experiments will take place must sign the form prior to it being sent to Occupational Health and Safety (See Section 12.0, Approvals). For research being done at Lawson Health Research Institute, London Regional Cancer Centre, Child and Parent Research Institute or Robarts Research Institute, University Biosafety Committee members can also sign as the Safety Officer.

TITLE OF GRANT(S):
Biophysical Basis of FMRI (CIHR)
SHEDDING LIGHT ON THE BOLD SIGNAL (NSERC)
HIGH RESOLUTION FMRI OF COLUMNAR STRUCTURES (NIH)

PLEASE ATTACH A BRIEF DESCRIPTION OF YOUR WORK, SUCH A THE RESEARCH GRANT SUMMARY(S) THAT EXPLAINS THE BIOHAZARDS USED. PROJECTS SUBMITTED WITHOUT A SUMMARY WILL NOT BE REVIEWED.

FUNDING AGENCY/AGENCIES NSERC / CIHR / NIH

Names of all personnel working under Principal Investigators supervision in this location:
i) Sarah Hughes
ii) Martyn Klassen
iii) Zheng Wang
iv)
v)

*** DESCRIPTION MUST BE ATTACHED TO THIS FORM OR PROJECT WILL NOT BE REVIEWED***

1.0 Microorganisms

1.1 Does your work involve the use of microorganisms or biological agents of plant or animal origin (including but not limited to viruses, prions, parasites, bacteria)? ☐ YES ☒ NO
If no, please proceed to Section 2.0

1.2 Please complete the table below:

Name of Biological agent(s)	Is it known to be a human pathogen? YES/NO	Is it known to be an animal pathogen? YES/NO	Is it known to be a zoonotic agent? YES/NO	Maximum quantity to be cultured at one time?
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

1.3 For above named organism(s) or biological agent(s) circle HC or CFIA Containment Level required. 1 2 3

1.4 Source of microrganism(s) or biological agent(s)? CERCOPITHECINE HERPES VIRUS 1 (ZOONOTIC STRAIN OF MACACA MULATTA)

2.0 Cell Culture

2.1 Does your work involve the use of cell cultures? ☐ YES ☒ NO
If no, please proceed to Section 3.0

2.2 Please indicate the type of primary cells (ie. derived from fresh tissue) that will be grown in culture in the table below

Cell Type	Is this cell type used in your work?	Source of Primary Cell Culture Tissue
Human	☐ Yes ☐ No	
Rodent	☐ Yes ☐ No	
Non-human primate	☐ Yes ☐ No	
Other (specify)		

2.3 Please indicate the type of established cells that will be grown in culture in the table below.

Cell Type	Is this cell type used in your work?	Specific cell line(s)	Supplier / Source
Human	☐ Yes ☐ No		
Rodent	☐ Yes ☐ No		
Non-human primate	☐ Yes ☐ No		
Other (specify)	☐ Yes ☐ No		

2.4 For above named cell types(s) circle HC or CFIA containment level required 1 2 3

*** DESCRIPTION MUST BE ATTACHED TO THIS FORM OR PROJECT WILL NOT BE REVIEWED***

3.0 Use of Human Source Materials

3.1 Does your work involve the use of human source materials? ف YES ف NO
If no, please proceed to Section 4.0

3.2 Indicate if the following will be used in the laboratory

- Human blood (whole) or other bodily fluids ف YES ف NO If YES, Specify _____
- Human blood (fraction) or other bodily fluids ف YES ف NO If YES, Specify _____
- Human organs (unpreserved) ف YES ف NO If YES, Specify_____
- Human tissues (unpreserved) ف YES ف NO If YES, Specify_____

3.3 Is human source known to be infected with and infectious agent ف YES ف NO
If YES , please name infectious agent _____

3.4 For above named materials circle HC or CFIA containment level required. 1 2 3

4.0 Genetically Modified Organisms and Cell lines

4.1 Will genetic modifications be made to the microorganisms, biological agents or cells described in Sections 1.0 and 2.0 ? ف YES ف NO
If no, please proceed to Section 5.0

4.2 Will genetic sequences from the following be involved:

- HIV ف YES ف NO
if YES specify_____
- HTLV 1 or 2 or genes from any CDC class 1 pathogens ف YES ف NO
if YES specify_____
- Other human or animal pathogen and or their toxins ف YES ف NO
if YES specify_____

4.3 Will intact genetic sequences be used from

- SV 40 Large T antigen ف YES ف NO If YES specify_____
- Known oncogenes ف YES ف NO If YES specify_____

4.4 Will a live vector(s) (viral or bacterial) be used for gene transduction ف YES ف NO
If YES name virus_____.

4.5 List specific vector(s) to be used:_____

4.6 Will virus be replication defective ف YES ف NO

4.7 Will virus be infectious to humans or animals ف YES ف NO

4.8 Will this be expected to increase the Containment Level required ف YES ف NO

*** DESCRIPTION MUST BE ATTACHED TO THIS FORM OR PROJECT WILL NOT BE REVIEWED***

5.0 Human Gene Therapy Trials

5.1 Will human clinical trials using the viral vector in 4.0 be conducted? ☐ YES ☒ NO
If no, please proceed to Section 6.0
If YES attach a full description of the make-up of the virus.

5.2 Will virus be able to replicate in the host? ☐ YES ☐ NO

5.3 How will the virus be administered? _____

5.4 Please give the Health Care Facility where the clinical trial will be conducted:_____

5.5 Has human ethics approval been obtained? ☐ YES ☐ NO

6.0 Animal Experiments

6.1 Will any of the agents listed be used in live animals? ☐ YES ☐ NO
If no, please proceed to section 7.0

6.2 Name of animal species to be used_____

6.3 AUS protocol # _____

6.4 If using murine cell lines, have they been tested for murine pathogens? ☐ YES ☐ NO

7.0 Use of Animal species with Zoonotic Hazards

7.1 Will any of the following animals or their organs, tissues, lavages or other bodily fluids including blood be used:

- Pound source dogs ☐ YES ☐ NO
- Pound source cats ☐ YES ☐ NO
- Sheep or goats ☐ YES ☐ NO
- Non- Human Primates ☒ YES ☐ NO If YES specify species MACAQUE
- Wild caught animals ☐ YES ☐ NO If YES specify species _____
  colony # _____

8.0 Biological Toxins

8.1 Will toxins of biological origin be used? ☐ YES ☐ NO
If no, please proceed to Section 9.0

8.2 If YES, please name the toxin_____

8.3 What is the LD_{50} (specify species) of the toxin_____

*** DESCRIPTION MUST BE ATTACHED TO THIS FORM OR PROJECT WILL NOT BE REVIEWED***

9.0 Import Requirements

9.1 Will the agent be imported? ☐ YES ☒ NO
If no, please proceed to Section 10.0
If yes, country of origin_____

9.2 Has an Import Permit been obtained from HC for human pathogens? ☐ YES ☐ NO

9.3 Has an import permit been obtained from CFIA for animal pathogens? ☐ YES ☐ NO

9.4 Has the import permit been sent to OHS? ☐ YES ☐ NO
If yes, Permit # _____

10.0 Training Requirements for Personnel named on Form

All personnel named on the above form who will be using any of the above named agents are required to attend the following training courses given by OHS

- Biosafety
- Laboratory and Environmental/Waste Management Safety
- WHMIS

As the Principal Investigator, I have ensured that all of the personnel named on the form who will be using any of the biohazardous agents in Sections 1.0 to 9.0 have been trained.

SIGNATURE _____

11.0 Containment Levels

11.1 For the work described in sections 1.0 to 9.0, please circle the highest HC or CFIA Containment Level required. 1 (2) 3

11.2 Has the facility been certified by OHS for this level of containment? ☒ YES ☐ NO

11.3 If yes, please give the date and permit number:_____

12.0 Approvals

UWO Biohazard Subcommittee

Signature G. M. Gilder Date 2 Oct '07

Safety Officer for Institution where experiments will take place

Signature N Stanley Date Sept 28/07

Safety Officer for University of Western Ontario (if different than above)

Signature_____ Date_____

* DESCRIPTION MUST BE ATTACHED TO THIS FORM OR PROJECT WILL NOT BE REVIEWED*

Functional magnetic resonance imaging (fMRI) has become the major tool for examining brain function in sensory and cognitive neuroscience, with over 4700 papers published in more than 500 unique journals as of 2002 (1). Despite this enormous acceptance across many disciplines, fundamental aspects of the fMRI response remain poorly understood in large part because of difficulties in linking studies in animal models under the confounding effects of anesthesia with those done in awake humans. The studies proposed here are aimed at understanding the links between neural activity in the brain, the blood flow, blood volume and blood and tissue oxygenation changes that follow, and the fMRI signal. These experiments will be performed in an awake macaque monkey model. Monkey models have the greatest relevance to human neuroscience, with the major advantage that they still allow minimally invasive measurements of electrophysiology, oximetry and flow.

This proposal represents an ambitious step in the direction of linking fMRI and physiology by three investigators at the Centre for Brain & Mind at UWO / Robarts. For Menon and Gati, it offers the unique chance to use multimodality measurements in animals to verify pioneering, yet contentious, fMRI measurements made in humans in our lab in the past 7 years. In order to focus on this important and exciting proposal, the PI has chosen not to renew his two productive CIHR operating grants that involved human fMRI work, one of which is part of the CIHR Group in Action and Perception. Therefore, this proposal is submitted as a new grant with a significant time commitment. For Everling, it offers the chance to use well-respected electrophysiology skills to answer important questions in fMRI and lay the groundwork for the use of fMRI in behaving (as opposed to passive) monkey models.

The **long-term objective** of our biophysical research program is to develop an understanding of the spatio-temporal characteristics of the fMRI signal in relation to the underlying hemodynamic response and neural activity. The techniques we will use to accomplish this are fMRI, electrophysiology, fluorescence quenching, laser Doppler and near-infrared spectroscopy at high spatial and temporal resolution in a well-characterized primate model. Well-known modular functional organization of the primary visual cortex (V1) offers us a variety of opportunities to explore the source of the fMRI signal. Our fundamental **hypothesis** is that hemodynamic responses to neural activity are modulated at a sub-millimeter scale in the primate brain. A consequence of this hypothesis is that we would predict that fMRI signals should reflect functional specialization of neurons at the cortical columnar and lamellar level. In order to test our fundamental hypothesis, we propose 5 experiments with the following 3 Specific Aims. **Specific Aim 1** will be to optimize fMRI parameters to obtain the highest spatial selectivity and sensitivity of BOLD *in-vivo*. **Specific Aim 2** will be to determine the spatial extent and temporal dependence of the fundamental underlying physiological quantities that the BOLD signal depends on. **Specific Aim 3** will be to use the responses of the quantities measured in Specific Aim 1 and 2 to generate a multi-parametric model that explains the BOLD effect in terms of its underlying physiological parameters. To quantify resolution of functional domains in the horizontal direction in the cortex, we will examine the physiologic and fMRI responses in ocular dominance columns (ODCs). To quantify the resolution in the vertical direction (depth) in cortex, we will measure these responses as a function of cortical layer. Electrical activity will be measured using both local field potentials and unit activity using tungsten electrodes. The redox state of the mitochondrial enzyme cytochrome oxidase (Cyt-aa3) in the cells will be measured using a novel near-infrared (NIR) spectrometer of our own design. The partial pressure of oxygen in the tissue (pO_2) will be measured using a commercial fluorescence-lifetime fiber optic technique (Oxylite, Oxford Optronix). The concentrations of oxyhemoglobin [HbO] and deoxyhemoglobin [Hbr] will also be measured using NIR spectroscopy (NIRS). Blood flow will be measured using a commercial fiber optic laser Doppler flow system (Oxyflow, Oxford Optronix).

Support for our hypotheses will not only help neuroscientists interpret human fMRI data in a more rigorous manner, but will establish the utility of fMRI for very high resolution functional, pharmacological, developmental and plasticity studies in animals, which are currently done by invasive means.

(1) J. Illes, M. P. Kirschen & J. D. E. Gabrieli. From neuroimaging to neuroethics. *Nature Neuroscience*, **6**: 205 (2003). *Data including 2001 was presented in this paper. the 2002 data came from Medline.*

NSERC

Personal identification no. (PIN)	Family name of applicant
194105	Menon

SUMMARY OF PROPOSAL FOR PUBLIC RELEASE (Use plain language.)

This plain language summary will be available to the public if your proposal is funded. Although it is not mandatory, you may choose to include your business telephone number and/or your e-mail address to facilitate contact with the public and the media about your research.

Business telephone no. (optional): (519) 663-5777 Ext. 34148

E-mail address (optional): rmenon@imaging.robarts.ca

Over the past 15 years, functional MRI has revolutionized our understanding of the spatial organization of human brain function. However, its physiological underpinnings remain elusive. MRI independent, higher sensitivity measurements at high spatial resolution are needed to fully understand how BOLD signal changes derive from physiological parameters that govern the relationship between neural activity and the subsequent hemodynamic sequelae. There are a number of optical techniques that can provide information on parameters such as cerebral blood flow, cerebral blood volume and vascular oxygenation on a relevant spatial scale. These same parameters govern the fMRI signal as well, but in a complex manner. The fMRI signal derives from the full thickness of the grey matter, but unfortunately these optical methods measure only on the surface of the brain, and it is not clear that these measurements reflect what goes on below the surface. The goals of this project are to measure the physiological parameters that underlie two forms of optical imaging (OIS and LSCI) and determine whether the surface measurements are reflective of the cortical vascular and oxygenation dynamics.

Second Language Version of Summary (optional).

DESCRIPTION: State the application's broad, long-term objectives and specific aims, making reference to the health relatedness of the project. Describe concisely the research design and methods for achieving these goals. Avoid summaries of past accomplishments and the use of the first person. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from the application. If the application is funded, this description, as is, will become public information. Therefore, do not include proprietary/confidential information. **DO NOT EXCEED THE SPACE PROVIDED.**

Our previous NIH funded high-resolution fMRI data in humans has motivated us to develop a better understanding of the spatio-temporal characteristics of the fMRI signal. The techniques we will use to accomplish this are fMRI (BOLD and AST based), electrophysiology, fluorescence quenching, laser Doppler and near-infrared spectroscopy at high spatial and temporal resolution in a well-characterized animal model. Well-known modular functional organization of the primary visual cortex (V1) offers us a variety of opportunities to explore the source of the fMRI signal. Our fundamental **hypothesis** is that hemodynamic responses to neural activity are modulated at a sub-millimeter scale in this model brain system. A consequence of this hypothesis is that we would predict that fMRI signals should reflect functional specialization of neurons at the cortical columnar and lamellar level. In order to test our fundamental hypothesis, we propose 6 experiments with the following 3 Specific Aims. **Specific Aim 1** will be to optimize fMRI parameters to obtain the highest spatial selectivity and sensitivity of BOLD and arterial spin tagging (AST) *in-vivo*. **Specific Aim 2** will be to determine the spatial extent and temporal dependence of the fundamental underlying physiological quantities that the BOLD and AST signal depends on. **Specific Aim 3** will be to use the responses of the quantities measured in Specific Aim 1 and 2 to generate a multi-parametric model that explains the BOLD effect in terms of its underlying physiological parameters. To quantify BOLD and AST resolution of functional domains in the horizontal direction in the cortex, we will examine the physiologic and fMRI responses in orientation columns. To quantify the BOLD resolution in the vertical direction (depth) in cortex, we will measure these responses as a function of cortical layer. Electrical activity will be measured using both local field potentials and unit activity using tungsten electrodes. The redox state of the mitochondrial enzyme cytochrome oxidase (Cyt-aa3) in the cells will be measured using a novel near-infrared (NIR) spectrometer of our own design. The partial pressure of oxygen in the tissue (pO_2) will be measured using a commercial fluorescence-lifetime fiber optic technique (Oxylite, Oxford Optronix). The concentrations of oxyhemoglobin [HbO] and deoxyhemoglobin [Hbr] will also be measured using NIR spectroscopy (NIRS). Blood flow will be measured using a commercial fiber optic laser Doppler flow system (Oxyflow, Oxford Optronix).

PERFORMANCE SITE(S) *(organization, city, state)*

Robarts Research Institute, London, Ontario, Canada
University of Western Ontario, London, Ontario, Canada

KEY PERSONNEL. See instructions. *Use continuation pages as needed* to provide the required information in the format shown below. Start with Principal Investigator. List all other key personnel in alphabetical order, last name first.

Name	Organization	Role on Project
Menon, Ravi, S.	Robarts Research Institute	PI
Bowen, Chris, V.	Robarts Research Institute	Research Associate
Everling, Stefan	University of Western Ontario	co-applicant
Gati, Joseph, S	Robarts Research Institute	Research Associate
St. Lawrence, Keith, S	Lawson Health Research Institute	co-applicant
TBD	Robarts Research Institute	Animal Technician

Disclosure Permission Statement. Applicable to SBIR/STTR Only. See instructions. ☐ **Yes** ☐ **No**