*A maximum of 400 words, accompanied by a list of preferred projects and supervisors*

A detailed research proposal is not required. Instead, you should provide a single document comprising both:

* a list of up to two research projects (and the associated supervisors) in which you are interested, in order of preference, selected from currently advertised projects; and
* an outline of your research interests, written in English, that clearly indicates the rationale behind your choice of projects.

Please be sure to also include all of the supervisor names in the supervisors field of the application form. However, there is no need to repeat the project titles in the research project field of the application form.

The 400-word limit applies to the outline of your research interests. There is no word-count limit for the list of preferred projects and supervisors.

If possible, please ensure that the word count is clearly displayed on the document.

Research Project:

1. Advance Nanoscale Engineering Group, Prof. Harish Bhaskaran,

Project: 1) Multi-Level Phase-Change Memory

2) On-chip Photonic synapse

Outline of Research Interest:

Throughout my journey in nanotechnology research, I have learned about experimental failures which eventually lead to a success in fabricating stable nanodroplets for ultrasound imaging and obtaining one of the highest scores in World Molecular Imaging Congress 2021. I became motivated to take on new projects related with nanotechnology. In Fall 2020, I learned about the neuromorphic chip through participating in an online seminar at Arthatelekomindo. The topic piques my interest because it consumes significantly less power than supercomputers to perform complex calculation and will help the advancement in science and technology.

With the support of my first research advisor, I decided to join the Hoffmann Research Group, the only research group at UIUC that focuses on neuromorphic computing. In this group, I performed materials growth as a spin source material that can be used to create networks of spin hall nano-oscillators. These devices have promising implementation scheme for neuromorphic computing as it mimics the functioning of the neural system by effectively generating spin currents to drive auto-oscillations in the nano-oscillators. The goal of my project is to optimize the thickness of CoPt thin multilayer films that give a high perpendicular magnetic anisotropy. After several iterations, I obtained a good thickness ratio of Co to Pt layers and the number of layers to produce a coercivity of 800 Oe, which is large enough for an ideal storage material and suitable for neuromorphic devices.

In that same semester, I took a nanotechnology course, and I had an open-ended project proposal, where I specifically chose novel memristor device based on 2-D and phase change materials for neuromorphic computing applications. I ended up liking the topic and would like to work on this topic for my master’s program because it involves interdisciplinary concepts, where I can contribute my knowledge in transport phenomena and lithography techniques.

However, I realized that I am lacking the knowledge of materials characterization, growth, processing, and modelling, which are the key concepts that allow me to create innovation in the fabrication of neuromorphic chips.

I believe studying materials science in Oxford will provide me with the tools I need to find novel materials for neuromorphic chip. In particular, I would like to join the advance nanoscale engineering group to work on Ge2Te­2Sb­5 (GST) phase change memory that is known for its low power consumption and its high-capacity data storage. I am interested in fabricating a crossbar-structured GST-based phase change memory array with a compatible electrode material.

My end goal is to apply the knowledge in materials science and chemical engineering in the industry and build my own start-up based on commercializing this novel neuromorphic technology that can sustain the future.

Hi Jonathan!

As a reader, I can really tell that you are highly interested in nanotechnology research and have gained experience and a considerable amount of knowledge.

You have outlined your interest in the field, but I believe you could be more specific to the 2 research projects you’ve chosen: 1) Multi-Level Phase-Change Memory and 2) On-chip Photonic synapse.

Based on your experiences and knowledge, why specifically these 2 projects? Why is Multi-Level Phase-Change Memory your first choice, then On-chip Photonic synapse? Mention the names of the projects in your outline as well.