PI name & contact details:	Prof Igor Shvets; Tel: +353 1 896 1653 e-mail: ivchvets@tcd.ie
School: ***Has project been agreed with head (or nominee) of proposed registration school?***	Physics
Research Centre / group affiliation:	Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) School of Physics – Applied Physics Research Group
Research group / centre website:	www.tcd.ie/Physics/applied-physics www.crann.tcd.ie
PI website / link to CV:	www.tcd.ie/Physics/applied-physics

Brief summary of PI research / research group / centre activity (2 or 3 lines max):
Multidisciplinary group working at the crossroads of physics, chemistry and materials science. The group research primarily related to the surfaces and interfaces of oxides, surface science, thin films, nanotechnology and computational physics in support of the experimental research. The group is a multicultural group of some 18 members, affiliated to the School of Physics and the Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN).

Title & brief description of PhD project (suitable for publication on web):

Metal-Insulator Transitions at surfaces and interfaces of highly localised conductors

Strongly correlated electron systems provide a fascinating test ground for some of the most fundamental questions in materials science. The essential building block in a typical system is a metal atom surrounded by four or six ligand atoms, forming either an octahedron or a tetrahedron. These blocks are arranged in such a way that ligand atoms are shared between neighbouring blocks. Despite persistent efforts and substantial progress achieved, comprehensive understanding consistent with experimental results is still a challenge. The situation with one- and two-dimensional systems is particularly difficult mainly due to shortage of reliable experimental results.

The PhD research proposes a coherent, focused approach to investigating metal-insulator transitions in low dimensional strongly correlated electron systems. The research will target the family of binary oxides. The key to success hinges on the growth of materials with superior atomic- and nanometre-scale control of defects and stoichiometry, structure of the surfaces and interfaces, and also differentiation between electronic properties of the bulk and the surface. The PhD research programme addresses the following two challenges related to low-dimensional strongly correlated systems: (i) establish the role of orbital ordering in metal-insulator transitions including methods for the suppression and enhancement of metal-insulator transitions through electron orbital ordering (ii) establish the conditions for electron transport by means of Boson-like electron pairs and the role of strain in forming electron pairs.

Completion of these research goals will advance the state-of-the-art of metal-insulator transitions and may lead to the discovery of next generation devices.

The project offers a highly motivated student the opportunity to spend 4 years in the Applied Physics Research Group where he/she will be exposed to cutting edge materials science research. The project has the potential to advance the state-of-the-art but also have definite applied potential in terms of electronic devices. The project would be suitable for a student with a background and interest in solid state physics/chemistry, or materials science looking to study in one of Europe's leading universities.

Unique selling points of PhD project in TCD:
projects should offer something that's not available in Brazil – specific equipment, multi-disciplinarity, aspects of structured programme, links with industry, placements, links with other research groups etc.

The Trinity PhD is a structured PhD and students can access discipline-specific training, as well as generic and

transferable skills. All PhD students are eligible to participate in the Innovation Academy which offers a Postgraduate Certificate in Innovation and Entrepreneurship to assist PhD students identify and exploit the value within their research.

The Applied Physics Research Group can offer state-of-the-art research infrastructure in its laboratories in the School of Physics and Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN). The group is multicultural and home to students from all walks of life and offers a stimulating intellectual environment in which students can influence the direction of their research. The group also has a history of research commercialisation, so there is the potential for involvement in research commercialisation.

Name & contact details for project queries, if different from PI named above:

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Please indicate the graduates of which disciplines that should apply:

Physics
Chemistry
Materials Science
Computational Physics
Theoretical Physics

Ciência sem Fronteiras / Science Without Borders Priority Area:

Please indicate the specific programme priority area under which the proposed PhD project fits- choose only one (tick box):

Engineering and other technological areas	
Pure and Natural Sciences (e.g. mathematics, physics, chemistry)	✓
Health and Biomedical Sciences	
Information and Communication Technologies (ICTs)	✓
Aerospace	
Pharmaceuticals	
Oil, Gas and Coal	
Renewable Energy	
Minerals	
Biotechnology	
Nanotechnology and New Materials	✓
Technology of prevention and remediation of natural disasters	
Biodiversity and Bioprospection	
Marine Sciences	
Creative Industry	
New technologies in constructive engineering	