



## **Institute of Technology**

### **Ciência sem Fronteiras / Science Without Borders**

#### **Postgraduate Project Template**

<b>Institution:</b>	Waterford Institute of Technology
<b>Title of Postgraduate Opportunity:</b> (include level of study)	An Investigation of Dielectric Thermoplastic Elastomers for Civil Infrastructural and Energy Harvesting Applications. PhD
<b>PI Name &amp; Contact Details:</b>	Dr Austin Coffey / Mr Philip Walsh Convergent Technologies Research Group Dept. Engineering Technology Waterford Institute of Technology, Ireland +353 51 302090 / +353 86 4041666 acoffey@wit.ie
<b>Department/School:</b>	Engineering
<b>Research Centre /Group:</b>	Convergent Technologies Research Group
<b>Research Centre/Group website:</b>	www.ctrg.ie
<b>Brief Summary of PI research / research group /centre activity</b> <p>The Convergent Technologies Research Group (CTRG) is a multi-disciplinary research cluster combining expertise in various fields of technology. The aim is to create a dynamic environment for collaborative research to deliver innovative solutions for convergent applications. Current research activities span a broad spectrum, ranging from infrastructural technologies (water, energy and the environment) through materials development (polymeric formulations, polymer processing and super-critical fluid enabled technologies) to passive and active medical devices (mock cardiovascular loops, catheter technologies and implantable platforms). CTRG has attracted significant funding and support from SFI, Enterprise Ireland, IOTI and multiple industrial partners; in the infrastructural, materials, microelectronic and biomedical sectors.</p>	
<b><u>Project Description</u></b>  <p>In the polymer field, dielectric thermoplastic elastomers (DTE's) are rapidly gaining recognition as an exciting and novel area of material science, with remarkable potential across a diverse application space. These materials are capable of reversible deformation in response to applied electrical fields and mechanical forces. Recently, it has been shown that when subjected to compressive forces, and similar</p>	

mechanical stresses, DTE's are capable of producing significant electrostatic energy which may be captured for energy harvesting applications, among many others. However, at present, the response characteristics of DTE's to electrical and/or mechanical stimuli is poorly understood, particularly in relation to their symmetrical nature. Insufficient documentation and metricisation of these operational mechanisms and parameters has therefore stifled their commercial exploitation and industrial uptake. The premise of this research is to address this paucity of scientific understanding. In doing so this work will seek to develop a comprehensive understanding of the physical, chemical, and electro-mechanical properties of DTE's, and the interdependent constraints that dictate their performance characteristics. Definition and parameterization of these issues will build on prior research, and in doing so will provide a springboard from which the advantages, limitations and application-specific suitability of DTE's can be evaluated. This is to be achieved by comprehensively reviewing the existing state of the art and subsequently implementing a dearth of scientific investigations, including the development of conjoined deformation-signal capture architecture. Analysis of measured and experimental data will be used to accurately define the parameters and constraints governing material performance characteristics and through industrial, inter-departmental and inter-institute collaboration, their suitability for deployment in a range of applications will be assessed. This will act as a stimulus for further research whereby material formulations, processing parameters etc. can be tailored/optimised towards their intended applications; which may include sensing, structural health monitoring, energy harvesting, actuation and artificial muscles to name but a few. It is intended that such revelations will carry significant commercialisation potential (including IP/Technology Transfer) and will serve to complement existing research into the applications of DTE's within the Institute, where critical mass has already developed at doctoral level.

**Key Attributes of Project for Brazilian Postgraduate Students**

The CTRG offers this research project to a candidate ready to embrace transdisciplinary research in an emerging and truly exciting field. Partnerships have been made with leading academic institutions in Ireland and the USA (University of Florida). Industrial technical partnerships have been secured. This research area has been shown through the CTRG group, as one of the most promising technologies to emerge in renewable energy. Ocean wave energy is one of the world's most powerful forms of energy and, as of yet, is a relatively untapped natural resource. The large attraction in the development of ocean wave energy is the fact that the energy density in ocean waves is the highest among renewable energy sources. The student will also become highly skilled in polymer processing, material formulation and electrical signal processing.

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

Dr Austin Coffey, [acoffey@wit.ie](mailto:acoffey@wit.ie)

**Please indicate graduate disciplines which are eligible for application:**

**Polymer Engineering**

**Materials Engineering**

**Mechanical Engineering**

**Electronic Engineering**

**Chemical Engineering**

**Physics**

**Alignment with Science Without Borders Priority Areas:**

Please indicate the specific programme priority area under which the proposed postgraduate project fits – choose only one (tick box)

Engineering and other technological areas	X
Pure and Natural Sciences (e.g. mathematics, physics, chemistry)	
Health and Biomedical Sciences	
Information and Communication Technologies (ICTs)	
Aerospace	
Pharmaceuticals	
Sustainable Agricultural Production	
Green Chemistry	
Oil, Gas and Coal	
Renewable Energy	X
Minerals	
Biotechnology	
Nanotechnology and New Materials	
Climate Change	
Biodiversity and Bioprospection	
Marine Sciences	
Productive Inclusion and Social Technologies	
Housing and Sanitation	