Position Title	PhD Studentship - Developing next generation lithium ion battery electrodes using nanoscience
Project Abstract	Society needs batteries with significantly enhanced energy storage capability. The simplest way to achieve this is to increase the electrode thickness and so enhance the area energy density. However, this simple idea raises a number of materials science challenges. Firstly, thick electrodes have high electrical resistance which leads to reduced performance, especially at high rate. In addition, even with polymeric binders, it is impossible to produce electrodes beyond a critical thickness without mechanical instabilities leading to immediate crack-induced failure. Thus, what is urgently needed is a new battery architecture which leads to electrodes which are extremely conductive in the out-of-plane direction to facilitate charge delivery but extremely tough (mechanically) in the in-plane direction to prohibit cracking. Here we will develop 3-phase composites consisting of mixtures of lithium storage material (e.g. silicon or metal oxide particles) with very small amounts of graphene and carbon nanotubes. We aim to use surface tension effects to bias the film formation to yield an in-plane aligned nanotube network leading to high in-plane mechanical toughness. In addition, we aim to use solution processing to coat the lithium storing particles with graphene. On film formation, the graphene will be trapped in the inter-particle interstices leading to an isotropic graphene network capable of rapidly delivering charge throughout the electrode. We estimate that by optimizing the electro-mechanics, such a system could yield >500 um thick electrodes, leading to capacities of >10 mAh/cm2 at rates up to 0.5C.
Experience	The PhD position is funded for 4 years, including a monthly stipend and materials and travel budget. Applicants should hold a minimum of an honours bachelor's degree at 2:1 level or equivalent in a relevant subject such as Physics/Chemistry/Materials. Candidates should also have a strong interest in 2D Materials/Energy.
Funding	The studentship will cover fees up to €5,500 pa and a stipend of €18,500 pa
Location	TCD
Closing Date	Friday 29th June 2018
For more information contact	colemaj@tcd.ie; +353 (1) 896 3859

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