Project Title*:	3-D printing of liquid crystal materials
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Faculty Research Area (Theme)*:	Advanced Manufacturing and Processing Technologies
School Research Area*:	Energy
Applicable to other Engineering schools/disciplines:	Biomedical Engineering Mechanical & Manufacturing Engineering Minerals and Energy Resources Engineering Photovoltaic and Renewable Energy Engineering Sciences – Maths, Physics, Chemistry
Abstract*:(Maximum 200 Words)	Additive manufacturing, or 3D printing, is a family of techniques that enable the fabrication of a solid object from a computer-aided design (CAD). 3D printing is becoming increasingly dominant in the field of advanced material processing and applications. Many of the traditional techniques are time-consuming and complex, requiring specialist equipment and training, as well as being hard to reproduce. Consequently, manufacturing costs escalate with increasing design complexity, making iterative designs financially wasteful and part- production times lengthy. On the other hand, 3D printing provides materials chemists and engineers with the ability to design, prototype and print geometrically complex functional devices that integrate nanoscale performance, biological property, electroactive, photoactive and catalytic functionalities. In order to be able to engineer the nano- and micro- scale architecture of the printed material, the inherent anisotropic properties of atomically thin 2D materials, such as graphene, will be harnessed to induce spontaneous formation of liquid crystal phases, resulting in self-ordered printing ink. Here, in a combined top-down and bottom-up approach, the freedom in micro scale design offered by 3D printing and the template-guided assembly of liquid crystal ink at the nano level, will allow significant structural control of the resulting 3D printed material.
Research Environment:(Maximum 100 Words)	The host of this project, Particles, and Catalysis Research Group (PARTCAT), is a leading (photo(electro)) catalysis research group within the School of Chemical Engineering at the University of New South Wales (UNSW).
Novelty and Contribution:(Maximum 100 Words)	The liquid crystalline phase will allow fine-tuning at the molecular level, while 3D printing controls the geometry of a device to define and regulate its final performance.
Expected Outcomes:(Maximum 100 Words)	The outcome will be a liquid crystallin ink made from novel materials such as graphene suitable for 3D printing

Reference Material Links:(Maximum 100 Words)	1] Jalili, R, Aboutalebi, SH, Esrafilzadeh,D, et. al. 2014, 'Formation and processability of liquid crystalline dispersions of graphene oxide', Materials Horizons, vol. 1, no. 1, pp. 87-91 2] Jalili, R, Aboutalebi, SH, Esrafilzadeh, D, et. al. 2013, 'Scalable one-step wet-spinning of graphene fibers and yarns from liquid crystalline dispersions of graphene oxide: Towards multifunctional textiles', Advanced Functional Materials, vol. 23, no. 43, pp. 5345-5354 3] Naficy, S, Jalili, R, Aboutalebi, SH, et. al. 2014, 'Graphene oxide dispersions: Tuning rheology to enable fabrication', Materials Horizons, vol. 1, no. 3, pp. 326-331
Will the student visit the premises of an industry partner, or undertake any activity on premises external to UNSW?*	No
Terms in which project can commence:	Term 2 Term 3