**Novel Containment Systems for Liquid Hydrogen Transport**

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Conventional tanks for liquid hydrogen ($LH_2$) are double-walled vacuum insulated vessels made from stainless steel, often incorporating additional materials in the vacuum space. These are heavy, expensive and challenging to fabricate for the large capacities needed in $LH_2$ shipping. Alternative materials might allow cheaper and lighter tanks to be fabricated. Polymers such as PTFE or PCTFE could be used as membranes or structural containers. Additionally, ice might be used as a structural material. The objective of the PhD will be to explore options for non-conventional $LH_2$ tanks including the use of polymeric materials, composites and/or ice. Alternative design concepts will be explored incorporating the suggested materials. Each concept will be assessed against acceptance criteria and knowledge gaps will be identified. Many of these will relate to material properties and selected experimental work will be carried out to address them. Materials and small-scale composite structures will be studied experimentally over a range of temperatures down to 77 K and the most promising strategies identified.

Key research questions to be addressed include:

- Does the low density of $LH_2$ allow non-conventional materials such as polymers, composites or ice to be used as structural materials?
- Will these materials withstand the cryogenic temperatures (~ 20 K) and present suitable mechanical properties.
- Is it possible to operate non-conventional tanks at an elevated pressure?
- What gaps exist in our knowledge of relevant material properties at cryogenic temperatures and can these be addressed via simple measurements carried out down to 77 K?
- What insulation options might be used as alternatives to conventional double-walled vacuum insulated constructions?
- If ice were to be used, how could this be accomplished and what techniques might be used to seal cracks?