HENRY ROYCE INSTITUTE

ADVANCED MATERIALS RESEARCH & INNOVATION

MATERIALS CHALLENGES TO ENABLE HYDROGEN DEPLOYMENT AT SCALE BY 2050

Challenge: Developing UK capability to test, set standards, and accredit new materials.

CONTEXT

Early-stage materials testing for some hydrogen applications has resulted in test methodologies that vary widely between researchers, such as those used for testing the impact of hydrogen on pipeline materials. This leads to challenges in comparing data sets and understanding the applicability of experimental results. Further, standardised safety inspection protocols are required to provide assurance of the lifetime of materials used with hydrogen, such as gas grid compressors.

Developing standardised testing methodologies to allow comparison of experimental results, and understanding materials degradation mechanisms, to develop testing and inspection protocols to provide ongoing safety assurance for hydrogen materials is a key requirement for hydrogen deployment at scale.

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MATERIALS RESEARCH CHALLENGE

Developing standardised materials testing methodologies for hydrogen will increase confidence in results and collaboration between those undertaking research in the hydrogen space, and further cement the UK's position as a leader in this field.

New standardised safety inspection protocols will need to be developed that are compatible with materials used with hydrogen. Since degradation mechanisms of materials subjected to hydrogen exposure are not always understood, it is not clear whether existing inspection and testing protocols provide sufficient safety assurance. These protocols are required to ensure safe operation of hydrogen equipment over its lifetime.

Often materials used with hydrogen are used under extreme temperatures – cryogenic for liquid or materials-based storage, and high temperatures in heat and power applications. A wide range of pH conditions are also used, along with water (either used to produce hydrogen or produced when hydrogen is used) which can cause corrosion issues. Work will need to be undertaken to understand in-use materials degradation with hydrogen in extreme temperatures and chemical environments.

Since the degradation mechanisms for materials used with hydrogen at high temperatures and under high mechanical stress are poorly understood, it is challenging to identify the signs of degradation that may lead to failure of components. One example of this is gas grid compressors, where failure of components could have significant consequences for the gas grid operation and approvals. New protocols are required to provide assurance of component lifetime during a gas grid compressor inspection.

UK CREDENTIALS AND WAY FORWARD

The UK has the capability to establish testing capabilities in hydrogen materials development. This will enable companies to test products here rather than seek testing capability overseas as they currently do, and will serve to further underpin the UK's leadership position in this field.

A cross industry/academic group is currently developing a more detailed proposal outlining the research challenges, resources and capabilities required to achieve a breakthrough in this area to enable widescale hydrogen deployment by 2050. This proposal will be available by the end of July for consideration for inclusion in the November spending review.

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