Disordered perovskite-type oxides using biominerlisation approach for H_2 related applications

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The world is shifting towards developing a hydrogen (H_2) economy to reduce the use of fossil fuel and escalating CO_2 emissions. Biological system has provided us inspirations to design and engineering new catalyst for green H_2 production. For example, microorganisms use proteins to make inorganic structures in an environmentally friendly process termed biomineralization. Compared to conventional synthesis, biomineralization approach can offer the capacity to make material with disordered structure, particularly wherein access to disordered surface structure is beneficial. This material could exhibit better catalytic performance for a variety of functional applications, such as $Ti_aZr_bO_x$ for HMF production which can be subsequently convert to H_2, or $Sn_aZn_bO_y$ for H_2 production as a by-product under CO_2 reduction reaction. Controllable bimetallic ratio could be achieved to modulate the surface active sites and material structures for performance optimisation. All materials are characterised using synchrotron characterisation to establish a relationship between the performance/selectivity and the material electronic/local structure. Through these efforts, we have demonstrated that biomineralization brings a new strategy to synthesis oxide-based catalyst for H_2 related applications.