CATALYSIS

Thermoelectric avenue

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Thermoelectric materials convert temperature differences into voltage and are therefore being explored in the context of power generation. However, their application in the field of catalysis is less well studied. Catalytically hydrogenating CO₂ is a useful route to produce hydrocarbon fuels directly and also to make CO, which is a convenient precursor to fuels and chemicals. Now, Zhaorong Huang and colleagues at Cranfield University and Queen Mary University of London exploit a thermoelectric material as a catalyst support for CO₂ hydrogenation, finding large changes in the performance that depend on the thermal gradient across the catalyst.

The researchers use BiCuSeO as the support for platinum catalysts as it has good thermoelectric properties, balancing high electrical conductivity and low thermal conductivity, and exhibiting stability up to 500 °C. To generate a temperature gradient across the BiCuSeO, one side of the reaction chamber is heated while the other side is cooled, creating temperature differences up to several hundred degrees Celsius. The researchers report 40-fold increases in CO₂ conversion to CO and CH₄ compared with a system that has the same surface temperature of the catalyst, but is operated under reduced thermal gradients. The relative proportions of CO and CH₄ that are produced are also affected. The researchers propose that the Fermi level, and therefore the work function of the catalytic particles on the support, is altered due to the thermoelectric effect induced by the temperature difference, giving rise to the increased activity of the catalyst.

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