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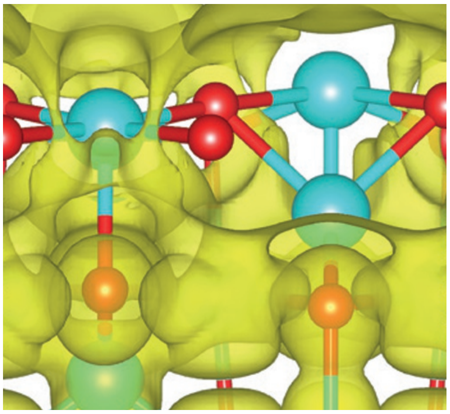
# research highlights

CO$_2$ REDUCTION

## Thin layers are best

*Angew. Chem. Int. Ed.* http://doi.org/f3j3rj (2015)



WILEY

Electroreduction of carbon dioxide to formate enables the storage of electricity in the form of chemical energy and can limit the release of greenhouse gases. Typically, the best electrocatalysts for such a reaction require expensive and scarce metals; thus, enhancing the performance of catalysts based on cheaper transition metal oxides is desirable. Now, Yi Xie, Yongfu Sun and colleagues at the University of Science and Technology of China in Hefei have shown that the electrocatalytic activity of thin layers of cobalt oxide can be greatly increased when their thickness is reduced to below 2 nm.

The researchers found that the current density of 1.72-nm-thick layers increased by a factor of 20 relative to the bulk. The improvement was attributed in part to the high fraction of low-coordinate surface atoms, which provided more active sites for the adsorption of carbon dioxide. After normalizing the activity by the electrochemically active surface area, the intrinsic activity was found to increase with decreasing layer thickness. Computational results suggested that the thin layers had greater and more dispersed charge density at the Fermi level compared with the bulk, giving rise to higher conductivity that could in part explain the higher activity. The 1.72-nm-thick layers also had superior stability and Faradaic efficiency compared with layers having a thickness of 3.51 nm. These results suggest that reducing the thickness to the nanometre scale is a promising approach for designing electrocatalysts for the conversion of carbon dioxide to fuels. *JG*

RESIDENTIAL HEATING

## What it takes to go green

*Energy Policy* **89,** 95–105 (2016)

Residential heating can account for as much as 20% of the energy demand of a country like Germany. As heat generation is largely achieved by burning fossil fuels, it also contributes substantially to carbon dioxide emissions. Thus, switching to residential heating systems based on renewable energy sources can be an effective means of meeting climate protection targets. However, switching relies in part on the decisions of individual homeowners to replace existing systems, making it important to understand what factors affect their choices. Carl Michelsen and Reinhard Madlener from RWTH Aachen University have now analysed what drives or hinders the uptake of renewable residential heating systems in the form of condensing boilers with solar thermal support, heat pumps or wood-pellet boilers.

The researchers analysed the response to a 2010 questionnaire of 2,682 German homeowners who had received grants to install renewable heating systems. They concluded that the uptake of renewable systems was mainly driven by concerns related to dependence on fossil fuels and environmental protection and by a greater knowledge of how these systems operate. Barriers to uptake were found to be system-dependent: mostly psychological for the heat pumps and mostly functional for the wood-pellet system. By identifying areas of concern for customers, these findings might guide policymakers and manufacturers to facilitate a transition to renewable heating systems. *ED*

SOLAR PHOTOVOLTAICS

## In it together

*Energy Res. Soc. Sci.* **10,** 90–101 (2015)

The interaction between electricity customers and utilities is being shaken by the increasing capacity of roof-top photovoltaic installations. Consumers that secure their power off-grid circumvent the charges and unit costs imposed by utilities, but they also stop contributing towards the maintenance of the grid infrastructure. Community solar projects — installations paid for and benefitting multiple community members or stakeholders — are an attractive alternative to residential installation; when sponsored by utilities, they allow consumers access to solar electricity they otherwise couldn't afford and act as a revenue stream for the utility provider. Now, Varun Rai and colleagues at the University of Texas at Austin have analysed the way that policy, regulatory and market factors influence the take-up by utility companies of community solar in the US to understand its potential scope.

The researchers carried out a series of interviews and surveys to explore the motivations behind the utilities for community solar deployment and the types of business model and strategies they employed. They also compiled a database of community solar programmes and examined residential solar capacity in regions with and without community solar availability. They found that utility adoption is driven predominantly by consumer demand for renewable energy and by policy and regulatory compliance. At the same time, utilities find that operating community solar projects allows them to retain their customer base while providing a stable model for distributed energy provision. *ND*

HYDROGEN STORAGE

## Letting it go

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Materials with small volume and low weight that can store a large amount of hydrogen are required in the development of hydrogen-powered vehicles and other mobile applications. Ammonia borane ($NH_3BH_3$) is a promising candidate; however, it is rather slow and inefficient at releasing the stored hydrogen. Hermann Wegner and colleagues at Justus Liebig University in Giessen have now reported a catalyst (9,10-dichlorodiboraanthracene) that enables the release of about 2.5 equivalents of molecular hydrogen per $NH_3BH_3$ molecule, which is the highest amount reported for metal-free catalysts.

The researchers showed that the catalyst can be used multiple times, as long as new batches of $NH_3BH_3$ are supplied, without compromising its catalytic activity. They also showed that the release reaction ceases upon cooling to room temperature, and quickly resumes after heating to 60 °C. Such thermal activation at a moderate temperature may be useful in applications that require intermittent release. The researchers rationalized the reaction mechanism from nuclear magnetic resonance data and first-principles calculations; the dehydrogenation is initiated by the attack of the hydride of $NH_3BH_3$ at the electron-deficient boron centre in the catalyst, and the rate-determining step then involves the breaking of both B–H and N–H bonds. *CZ*

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