

## Photoelectrocatalytic conversion of CO<sub>2</sub>: Application of transition metal functionalised diamond particles

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Synthetic diamond materials have been successfully used to convert carbon dioxide to carbon monoxide or even formaldehyde, either photocatalytically<sup>1,2</sup> or electrochemically<sup>3</sup>. Those materials provide a cheap and safe alternative for the generally used metal or metal-oxide catalysts.<sup>4</sup> Concerning photocatalytic carbon dioxide reduction processes involving diamond, solvated electrons play an important role as powerful reducing agent. For the generation of those electrons, hydrogen-terminated materials and UV light irradiation ( $\lambda < 225$  nm) are required.<sup>1,2</sup>

However, the electronic properties of diamond can not only be influenced by its termination, but also by different surface functionalisations. Diamond electrodes have already been used for anchoring photo- and electrocatalytically active molecules. Among various transition metals, several ruthenium-complexes, showing high redox and photocatalytical stability under ambient conditions<sup>5</sup>, have been preferentially attached to BDD electrodes.<sup>6-8</sup>

In this work we present the immobilisation of transition metal complexes on linker-functionalised nanodiamond particles using the concept of click-chemistry. The resulting conjugates have been characterised using various spectroscopic methods investigating the influence on the electronic structure of the particles. Their ability to reduce carbon dioxide in photoelectrocatalysis is shown in the production of formate at significantly higher rates than for unfunctionalised reference materials.

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