A golden future for oxidation reactions in the chemical industry

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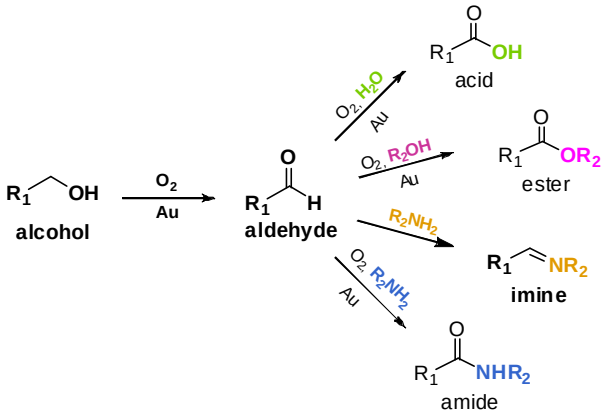
Abstract

To develop a more sustainable chemical industry, there is an urgent need for more efficient and environmentally benign oxidation processes for production of the important chemicals which find use in our everyday products [1]. Today industrial oxidations are typically carried out using stoichiometric amounts of oxygen-containing metal reagents (such as chromate or permanganate), which leads to generation of large amounts of hazardous metal waste. Going from bulk to fine chemicals the amount of waste increases dramatically, and special chemicals like pharmaceuticals can result in even more than 100 kg of waste per kg of product [2].
Utilization of oxygen as stoichiometric reagent in catalytic oxidation reactions (i.e. aerobic oxidations) represent a green and highly atom-efficient reaction protocol, as oxygen is a cheap and abundant oxidant that produces water as the only by-product. Efficient aerobic oxidation is, however, dependent on a good heterogeneous catalyst that provides readily activation of the oxygen in order to allow the reaction to occur.

Here, we show that supported gold nanoparticles form active and highly selective heterogeneous catalysts in a range of aerobic oxidations. The formation of imines by oxidative coupling of alcohols and amines was primarily investigated, but transformation to chemicals with other important functional groups such as acids, esters and amides are also possible (Scheme 1) [3]. The applied oxidizing agent was pure oxygen and the reactions were conducted under ambient conditions and at high substrate concentration. These reaction conditions comply with the most important principles of green and sustainable chemistry.



Scheme 1. Possible oxidation reactions using supported gold nanoparticles as catalysts.

References

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[3] S. Klitgaad et al., *Green Chem*., 2008, **10**, 419; C. Marsden, *Green Chem., 2008, **10**, 168*