Energy-efficient plastic production

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Davide Crapanzano of the University of Twente (The Netherlands) has demonstrated the conditions under which a new catalytic membrane can be used for the cheaper, faster and more energy-efficient production of raw materials for the plastics industry. In this way propane can be more quickly converted into propene, and then for example into polypropene, which is used as a raw material for garden furniture, car components and other products.

Most plastics are manufactured from crude oil, and the processing of crude oil generates many alkanes, which are hydrocarbons that can really only be used as fuel. If these alkanes are converted into compounds that can be used as building blocks for plastics, however, they can be used in many other ways. Davide Crapanzano of the University of Twente has demonstrated the conditions under which a new catalytic membrane can be used to selectively convert alkanes into ingredients for plastic products such as garden furniture and car components.

In the petrochemical industry the conversion of alkanes into monomers, the building blocks of plastics, is carried out through selective oxidation. In this process oxygen is used to change the hydrocarbons into the desired molecules. Selective oxidation has been used on a large scale for many years. The great disadvantage of the process, however, is that it only produces a small amount of the end product, because the desired molecules continue reacting very quickly, with the result that they combust, leaving CO2 and water. That results in high costs, many waste products and high energy use to separate the desired products from all the unwanted products.

Crapanzano developed a new way of avoiding these drawbacks. Instead of mixing the alkane with oxygen, the PhD student used a membrane that is capable of conducting the oxygen ions. On one side of the membrane oxygen ions are produced from molecular oxygen, while on its other side the oxygen ions selectively react with the alkane, for example converting propane into propene. This prevents the desired products from oxidizing any further. Davide investigated which materials are capable of reacting selectively with propane, and the conditions under which this is possible. It turned out that the concentration of the oxygen ions in particular has a major influence. The potential cost reductions are huge.

Crapanzano obtained his PhD on 28 May from the Faculty of Science and Technology.

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