

Carbon nitrides and Metal Nitrides: Towards Artificial photosynthesis

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Nitrides and carbides are a class of materials which is presumably next on the market to complement current functional oxides or carbons.

Graphitic Carbon Nitride (ideally C_3N_4) for instance is a graphite-like material, however with semiconductor properties and extreme chemical stability. Most metal nitrides exhibit high chemical stability and functional physical properties such as hardness, high wear resistance, electrical conductivity, or even superconductivity. E.g., TiN is used particularly as coating agent for cutting tools, but also as catalyst, while WC and Mo_2C are powerful catalysts, even considered as potential substitutes of noble metal in fuel cell catalysis.

Recent work has shown that such structures are less exotic than thought, but can also be formed under ambient or moderate conditions I will report on the so-called urea-glass route, where metal nitrides and/or metal carbides nanostructures are obtained in a sol-gel type reaction sequence. I will also report on the superior performance of those particles in superparamagnetism, catalysis, and battery applications.

Graphitic carbon nitride finally is most surprising. Made from urea under early-Earth conditions, as shown already by Justus Liebig in 1832, it just recently turned out to be a novel catalyst which- among other reactions- can even chemically split CO_2 or photochemically water. This opens the door to artificial photosynthesis on the base of a sustainable and most abundant substrate base.