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The many Faces of Phosphorus Chemistry

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Phosphorus chemistry is highly important in many aspects of our modern society, ranging from the origin of life, over biomedical and pharmaceutical applications to technical solutions for actual problems. The lecture will focus on three different domains in which phosphorus chemistry is playing a crucial role.

Firstly, the use of phosphorus acids will be discussed as a new technology for the valorisation of low temperature waste heat. The amount of low temperature industrial waste heat is estimated to be 180GW for the EU, so that an economical feasible system to recuperate part of this energy is very important in view of lowering carbon dioxide emissions. Mimicking the natural ADP/ATP energy cycle of living cells, a technological relevant heat transformer was developed in collaboration with Q-Pinch and is being commercialized on pilot scale and on industrial scale.[1] The heat transformer allows to pump up the temperature of the waste heat with about 70°C with a yield of 50%.

Aminophosphonic acids are known as potent enzyme inhibitors since they act as structural mimics of the transition state during hydrolysis of peptides. Therefore, much efforts are being performed to synthesize new types of aminophosphonates. Over the years, we have been involved in developing strategies to produce new types of aminophosphonates in a straightforward synthetic manner. Our efforts led to the development of a one-step protocol for the synthesis of diphosphonylated aminophosphonates from □,□-unsaturated imines through a tandem 1,4-1,2-phosphite addition [2], as well as its application to numerous azaheterocyclic scaffolds, *e.g.* quinolines, phenanthrolines and napthyridines. For a long time, the pyridine nucleus was not reactive in this diphosphonylation approach. Recently, we succeeded in the di- and triphosphonylation of pyridines under quite stringent conditions [3].

As a third aspect, the initial results towards the synthesis of C-P analogues of psilocybin, a natural occurring hallucinogenic indole isolated from, amongst others, *Psilocybe cubensis*, will be discussed. This psychedelic natural compound is getting more and more attention because of its outstanding anti-depressive activity. New analogues are being prepared to study the blood-brain barrier transition potential and the biological activity towards certain enzymatic systems [3]. The initial results and challenges in this exciting endeavour will be discussed.

References

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