C9: Switchable selective collectors for flotation of engineered artificial minerals

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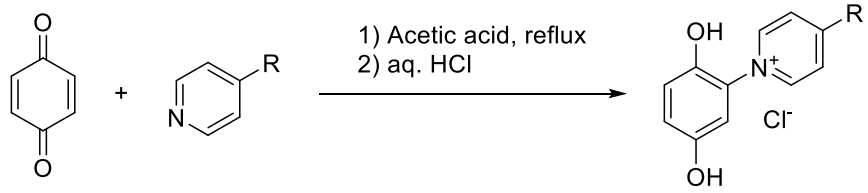
Overview

The SPP 2315 is concerned with the effective separation of target engineered artificial mineral-particles (EnAM) from its gangue material. In pillar C of this priority programme, our group focuses on switchable molecules called “puncines”, which are applied as highly selective collector molecules in separation *via* flotation. As flotation is based on the difference in the surface hydrophobicity of dispersed particles, the collector molecules aim to create more favorable conditions for the attachment of desired minerals to air bubbles.[1,]
The focus of our work lies on identification, synthesis and characterization of optimized punicine derivatives for a strategic application as collector molecules for lithium as well as other resources, e.g. precious earth elements.

Punicine is a natural, eco-friendly betainic alkaloid isolated from the leaves of *Punica granatum.*[2] Opposite to many natural alkaloids, it is also readily available and modifiable on a straightforward synthetic route (**Scheme 1**). Modification possibilities are e.g. introducing an alkyl chain to gain tensidic properties, however many other possibilities exist.



R = H, Alkyl,...

Scheme 1: Easy synthetic approach to punicine and its derivatives.

Previous studies proved a selective interaction with metals, metal oxides as well as particles.[3] Furthermore, punicines have proven to possess switchable properties (pH- and light-dependent) (**Figure 2**).[2] This switchability and the resulting interactions with surfaces of EnAM-particles is of particular research interest.

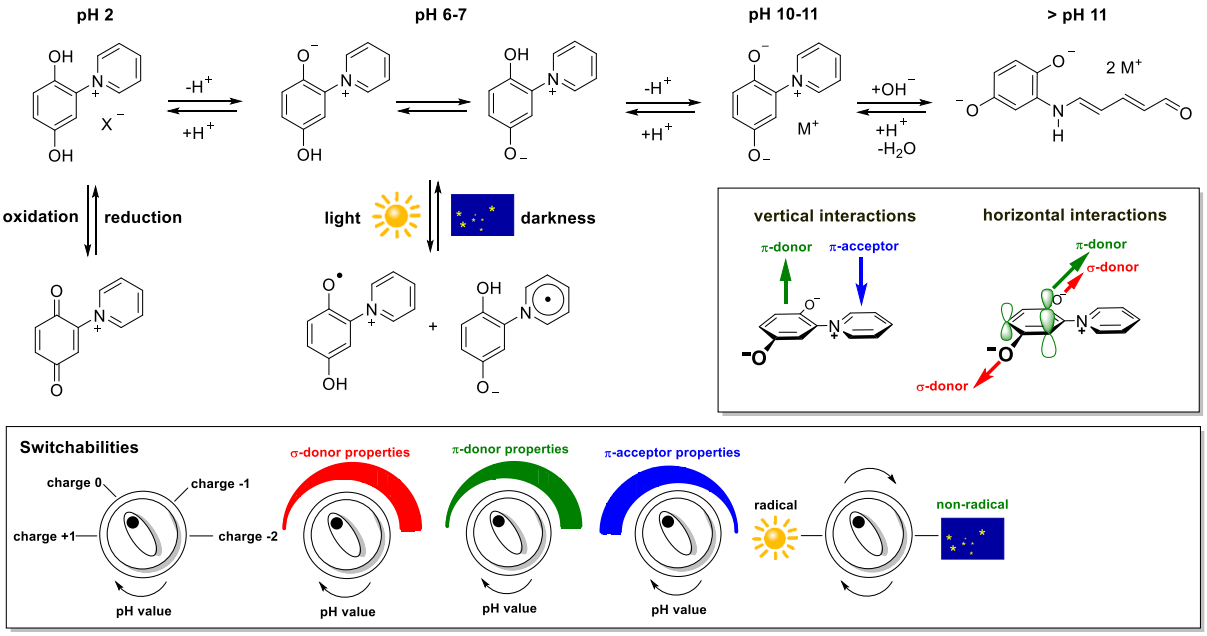


Figure 1: Switchability of punicines is originating from different charges and radical status, numerous properties can be switched „on and off“ *via* pH or irradiation adjustments.

Particle system

The particles used in this project are different types of the EnAM, mainly $LiAlO_2$, $LiAlSi_2O_6$, Li_2O, as well as gehlenite and different other forms of Li mineral.

Characterization

An important determination is the evaluation of the effectiveness of our collector molecules in froth flotation processes. To achieve this, micro flotation experiments under varying conditions (pH, light, collector concentration) in a HALLIMOND-tube are carried out. In addition to that, AFM examination to measure the adsorption interaction, IR/Raman to gain knowledge about the complexation and zeta potential measurements to investigate the flotation performance and efficiency are performed. Tensiometry with a bubble pressure tensiometer to analyze the surface tension, contact angle measurements to quantify the wettability and the dynamic froth image analysis of the switchable punicine collectors are means to gain a better understanding of the underlying mechanisms of froth flotation separation and the interaction of EnAM-particles with our collector molecules. In addition to that, NMR spectroscopy is the method of choice to chemically characterize the molecules. This method is also used to gain information about switchability properties as well as interactions with slag particles or other metal ions.

References

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[2] A. Schmidt, T. Mordhorst, M. Nieger, *Nat. Prod. Res.,* **2005**, 19, 541-546.

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