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Sorption of Pesticides to Natural and Synthetic Nanoparticles

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Many organic pollutants tend to associate with particles in environment. Such interactions with solid surfaces may not only alter the reactivity and bioavailability of pesticides, but also their uptake. This alteration may occur both in the way and in the amount the compound enters the organisms. In its turn this may change the overall effects of these compounds on organisms and ecosystems. The main goal of the work presented here is to provide mechanistic information on the sorbate-sorbent interactions between nanoparticles and a set of pesticides under environmentally relevant and physiological conditions. As such, the work is part of the interdisciplinary graduate research program EXPAND at the University of Tübingen investigating molecular interactions between pesticides and particles to elucidate how such interactions impact the toxicological effects.

To this end, natural and synthetic nanoparticles covering a wide range of physicochemical properties and pesticides for different target organisms were used. Sorption experiments were carried out with insecticides (imidacloprid; thiacloprid), fungicides (hexaconazole; propiconazole) and herbicides (glyphosate with its metabolite AMPA; glufosinate). The choice of the pesticides was based on their environmental significance and their mode of action. Both engineered nanoparticles with tailored surface properties and nanoparticles of natural origin were characterized and applied to cover various modes of sorptive interactions with the pesticides.

The impact of various geochemical and physiological conditions including pH, temperature, ionic strength, background electrolytes and DOM (dissolved organic matter) on the sorption of the pesticides to nanoparticles was studied. Sorption kinetics and sorption isotherms were determined and the results are discussed in terms of predominant sorption mechanisms and the suitability of certain nanoparticles for toxicological studies in the framework of the EXPAND project.