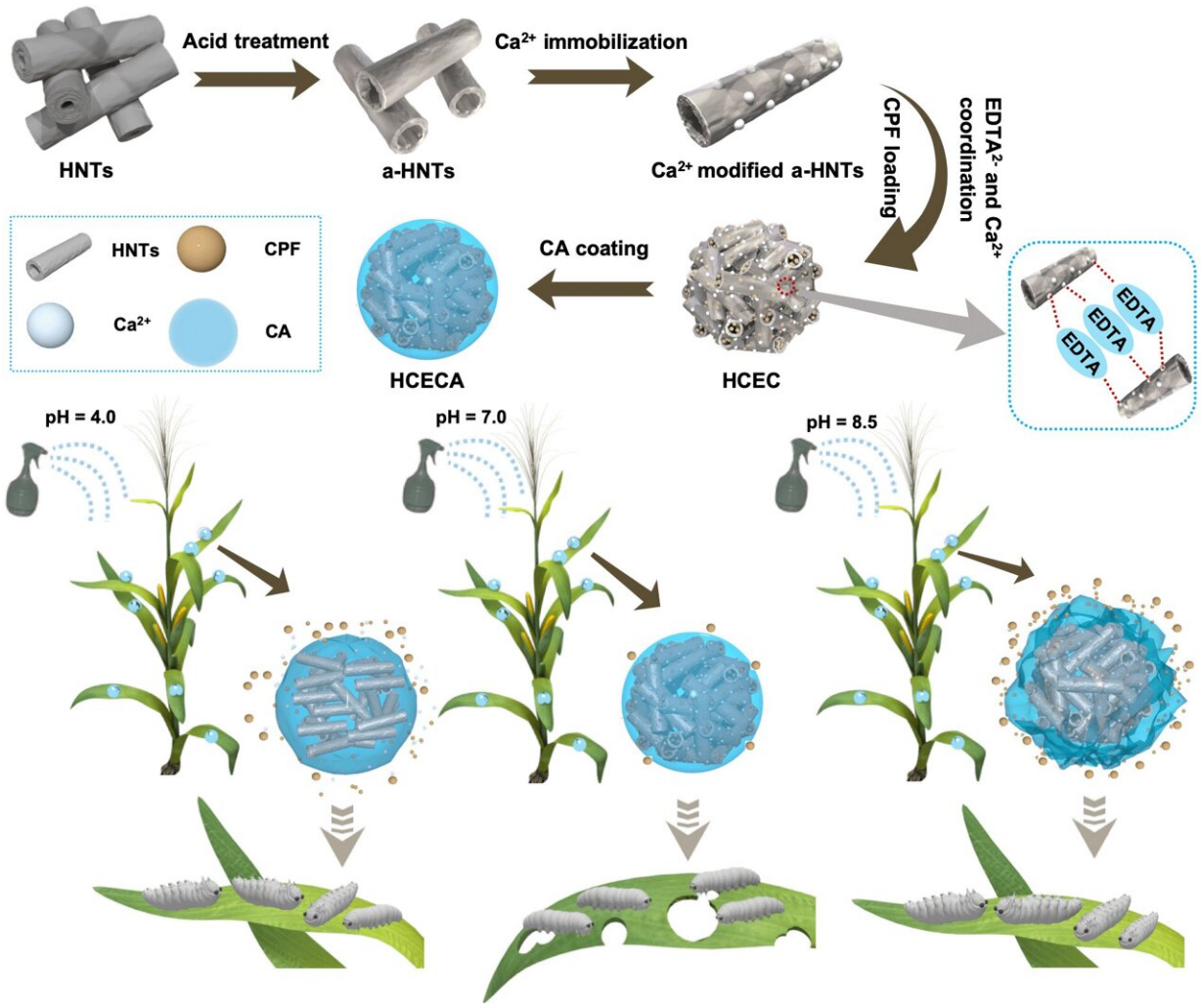
Scientists fabricate acid/alkali dual PH-responsive smart pesticide delivery system

September 15 2022, by Teng Guopeng



Schematic illustration of fabrication and mechanism of HCECA. Credit: Teng Guopeng

Light, electric field, alternating magnetic field, and pH have been used as triggers to boost the release of pesticides, among which the pH-responsive type attracts broad interest due to simple operation and low cost.

Most pH-controlled pesticides exhibit monotonic response to acid or alkali, and thus the large-scale application is limited, since the pH of water for agricultural spraying may vary between weakly acidic and weakly alkaline among places. Devising acid/alkali dual pH-responsive controlled-release pesticides that are flexible in multiple application situations could help overcome this challenge.

According to a paper published in *Chemical Engineering Journal*, a team led by Prof. Wu Zhengyan in the Institute of Intelligent Machines, Hefei institutes of physical science of Chinese Academy of Sciences managed to develop a novel type of responsive material with acid/alkali dual pH sensitivity to deliver hydrophobic pesticide by the combination of acid-sensitive calcium ion (Ca^{2+})-ethylenediamine tetraacetate ($EDTA^{2-}$) complex and base-sensitive calcium alginate.

During the loading of chlorpyrifos, assembly occurred spontaneously by mixing Ca^{2+}-modified acid-treated halloysite nanotubes (a-HNTs) with $EDTA^{2-}$, followed by the functionalization of alginate gel to obtain the smart pesticide delivery system (HCECA).

The loading capacity and loading efficiency of the system for chlorpyrifos were 130 mg/g and 65%, respectively, showing a dual pH-responsive controlled release behavior.

At the same time, the system displayed excellent foliar adhesion performance, high temperature resistance and UV resistance, which could significantly reduce loss, prolong the duration of pesticides, and improve the utilization rate.

Notably, the carrier material showed excellent biocompatibility in testing of toxicity on zebrafish. The halloysite nanotubes-based gel material serves as a promising carrier for hydrophobic pesticide to be applied in controlled management of agricultural hazards.

More information: Guopeng Teng et al, Halloysite nanotubes-based composite material with acid/alkali dual pH response and foliar adhesion for smart delivery of hydrophobic pesticide, *Chemical Engineering Journal* (2022). DOI: 10.1016/j.cej.2022.139052

Provided by Chinese Academy of Sciences