**Construction of Au NPs/P-C3N4 heterojunction for high-performance photoelectrocatalytic monitoring and degradation of 4-chlorophenol**

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Highly poisonous organic pollutants (e.g. pesticides, phenolics and toxins) discharged into the environment have posed great threats to public health and ecological security. Developing simple and efficient approaches that could be simultaneously used for the monitoring and degradation of these contaminants is highly anticipated (Adhikari *et al*. 2019). On the strength of photo/electrocatalytic methods, an emerging route of photoelectrocatalytic approach has received enormous interests in the environmental monitoring and remediation, on account of its high efficiency, easy operation, and robust catalytic activity. Essentially, the photoelectrocatalytic performance is related to the microstructures and configurations of semiconductor-based photoactive nanomaterials. Recently, considerable efforts have been dedicated to the fabrication of various heterojunctions (Shi *et al*. 2019), since they could remarkably improve the light absorption and photoelectric conversion efficiency attributed to a rapid separation and transportation of photogenerated electron-hole pairs in the heterojunction interface.

In this work, a novel heterojunction of Au nanoparticle decorated phosphorous doped carbon nitride (Au NPs/P-C3N4) is prepared, and as a paradigm, its photoelectrocatalytic performance towards monitoring and degradation for the selected pollutant of 4-chlorophenol is investigated. The P-C3N4 nanobelts are firstly synthesized with a simple solvothermal template-free approach, following by a wet chemical reduction of Au NPs on the nanobelts. On the one hand, the P doping is favourable to expose more active sites of C3N4, extend its absorption threshold, enhance the conductivity, and facilitate the separation of electron-hole pairs (Wang *et al*. 2019). On the other hand, ascribed to the local surface plasmon resonance (LSPR) effect, the decoration of Au NPs could not only enhance the electron transfer, but also improve the light absorption and photoelectric conversion efficiency (Murdoch *et al*. 2011). Based on this synergetic effect, a significantly enhanced photocurrent on Au NPs/P-C3N4 (∼4-fold of P-C3N4) is achieved. Serving as the electron donor, the presence of 4-chlorophenol is able to consume the photo-excited holes, thus suppressing the recombination of electron-hole pairs and realizing a sensitive monitoring of 4-chlorophenol. As a result, the proposed heterojunction shows a lower detection limit of ~50 nM towards 4-chlorophenol, and a robust photoelectrocatalytic degradation of ~90% 4-chlorophenol in aqueous solution. Moreover, the heterojunction exhibits an acceptable selectivity, excellent stability, and good reproducibility and repeatability. The outstanding performance of prepared heterojunction opens a new horizon for the promising photoelectrocatalytic monitoring and degradation towards different organic pollutants in environment.

**References**

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