A Novel Reactor with a Transparent Electrode to Improve UV-Mediated Electrochemical Wastewater Treatment

Huang, Victor

Foong, Brandon

Electrochemical Advanced Oxidation Processes (EAOPs) have gained interest recently for their ability to continuously degrade waste compounds without the need for a constant supply of chemicals. In addition, these EAOPs can be aided by UV. In conventional bench-scale electrochemical reactors, UV light can only be shone from the top which is impractical when scaled up. In our study, we explored the feasibility of using transparent electrodes to optimize the effect of UV light in electrochemical wastewater treatment; and designed a miniature reactor that employed multiple EAOPs. The transparent electrodes allowed for a reactor design whereby UV could shine from the side directly onto the electrodes where UV-dependent EAOPs would take place. We found fluorine-doped tin oxide (FTO) coated glass to be a stable anode at pH 3, with a maximum transmittance of 63.7% in the UVA (320 to 400nm light) which was sufficiently transparent. The FTO glass anode was thus chosen alongside carbon felt cathode, which had the highest rate of H2O2 production (compared to carbon cloth & graphite block). We then tested FTO and carbon felt under beaker conditions to compare the effects of UV light and Fenton catalyst. In our validation experiments, we observed a significantly greater improvement in rate of phenol degradation in our reactor (74%) than the conventional batch beaker (15%) when UV light and Fenton catalyst (Fe2+) were applied as compared to the baseline conditions (without light or Fenton catalyst). The design of this reactor is likely to be effective even when scaled up, and could potentially be used with parabolic reflectors to utilize sunlight for greener and cheaper electrochemical wastewater treatment.