

NOVEL METHODS FOR PREPARATION OF
MODIFIED 1-DIMENSIONAL NANOMATERIALS OF TITANIUM DIOXIDE FOR
ENVIRONMENTAL ENGINEERING APPLICATIONS

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ABSTRACT

Current modification of 1-Dimensional (1-D) titanium dioxide nanomaterials to enable visible light, particularly nitrogen doping, still have shortcomings. The primary objective of this doctoral study is to develop novel methods of preparation and modifications of 1-D titanium dioxide nanomaterials for achieving activation with visible while addressing shortcomings of currently available method. Two types of 1-D titanium dioxide nanomaterials including nanotube and nanofiber are selected as the research targets.

Titanium dioxide nanotubes were prepared through the popular anodization method, then subjected to treatment by plasma processing techniques with either nitrogen and nitrogen/carbon monoxide as feeding gases. Titanium dioxide nanofibers were successfully prepared by a novel method based on electrospinning with polyacrylonitrile, which enable in situ nitrogen doping of nanofibers. In subsequent photocatalytic experiments with methylene blue, the plasma treated titanium dioxide nanotubes and the electrospun titanium dioxide nanofibers exhibited activation with visible light as desired.

Moreover, the as-prepared modified 1-D titanium dioxide nanomaterials were utilized in degradation experiments of benzene, toluene, ethyl benzene and xylene (BTEX) in water under visible light. Experimental results showed that the as prepared modified 1-D titanium dioxide were able to degrade BTEX components in water via the photocatalytic processes initiated by visible lights. Comparing to current Best Available Techniques and Best Possible Techniques, it is assessed that treatment techniques of produced water built upon modified 1-D titanium dioxide nanomaterials is promising with high effectiveness and sustainability.