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Novel TiO_2 prepared from titanyl sulphate by using pressurized water processing and its photocatalytic activity evaluation

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Graphical abstract

Highlights

- A novel preparation approach of TiO_2 anatase from titanyl sulphate by using pressurized water processing.
- Processing temperature affects crucially the TiO_2 anatase crystallization.
- Correlation between Raman FWHMs and XRD determined anatase crystallites-size enabling the estimation of anatase crystallites-size from Raman spectra.
- The anatase crystallite-size and surface area are determining properties in AO7 photo-discolorization.
- The band gap structure and rate of recombination of electrons and holes are the determining properties in N_2O photodecomposition.

Abstract

TiO_2 anatase was prepared by a novel preparation approach, combining utilization of titanyl sulphate as a precursor and pressurized water processing. In addition, two different chemical methods for preparation were used – thermal hydrolysis and induced hydrolysis. The photoactivity of developed TiO_2 was examined in two environmentally-prospective reactions: azo-dye AO7 photodiscoloration (oxidation) and N_2O photodecomposition (reduction). It was revealed that during the processing the temperature has a crucial effect on TiO_2 crystallization contrary to pressure. TiO_2 anatase of smaller crystallite-size showed significantly higher photoactivity in AO7 photodiscoloration than TiO_2 anatase of large crystallite-size. However,