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Enhancement of atmospheric plasma removal of VOCs using porous dielectric conformally coated with titanium dioxide by atomic layer deposition

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The use of atmospheric pressure plasmas to remove organic volatile compound (VOC) contamination from different atmospheres is a current area of research for pollution control. Dielectric barrier discharge (DBD) systems are widely used to produce non-thermal atmospheric pressure plasmas. The combination of DBD discharge together with catalytic decomposition has been widely studied for VOC abatement. In this paper, we report on the use of atomic layer deposition (ALD) to deposit titanium dioxide catalytic thin film in porous glass labyrinths. ALD has been shown to produce effective photocatalytic TiO_2 layers and one of its characteristics is to be able to deposit on the internal surfaces within a complex porous material. The performance of a parallel plate DBD system has been tested for the reduction of VOCs, in particular ethyl acetate, toluene and a mixture of these. The performance has been compared under conditions of DBD only, DBD with porous glass interelectrode material to increase the flow path of the gases, to increase the intensity of micro discharges in the porous cavities and to maximise the surface area of the interelectrode medium and also with the porous glass material coated with titanium oxide layers to enhance the decomposition. The conversion of the VOCs to CO_2, CO and water as a function of the specific input energy (SIE) was measured as a function of the pore size of the glass. The breakdown products of the decomposition were determined by using FTIR absorption measurements of the exhaust gases. The figure shows the decomposition products as measured by FTIR.

Keywords
dielectric barrier discharge
photocatalyst
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