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Porous nanostructure thin film titanium dioxide synthesized by atmospheric microwave plasma

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In certain environmental photocatalysis applications, we use preferably photocatalytic material in form of thin film than in powder. Porous nanostructure thin film structure shows larger treatment area and immobilized nanoparticles. Porous nanostructure TiO_2 is successfully synthesized as thin film by surface wave atmospheric microwave plasma torch in continuous mode at reasonable power. Titanium tetraisopropoxide is used as a precursor and fed into the system using a bubbler under argon flow to deposit TiO_2 thin film on quartz substrate. Raman spectra confirm the formation of anatase phase necessary for photocatalytic activity. UV spectra transmittance percentage decrease, by discharge time increase, indicates appreciable film thickness formation.

1. Introduction

Titanium dioxide (TiO_2) thin film have many applications as photocatalysis and dye-sensitized solar cells, [1]. Porous nanostructure TiO_2 thin film may be very interesting in many environmental applications especially water treatment due to great surface area and immobilized nanoparticles.

A promising technique to synthesize thin layer TiO_2 is atmospheric microwave plasma torch driven by surface-wave.

2. Experimental setup

Plasma is generated by a waveguide atmospheric plasma torch driven by surface-wave as in Fig. 1. The source consists of 2.45 GHz microwave generator for which incident and reflected power are optimized to couple 300 W in plasma.

Titanium Tetraisoproxide (ACROS Organics, +98% purity) is nebulised into a quartz discharge tube 30 cm long and 8 mm inner diameter in which plasma is formed under argon gas flow.

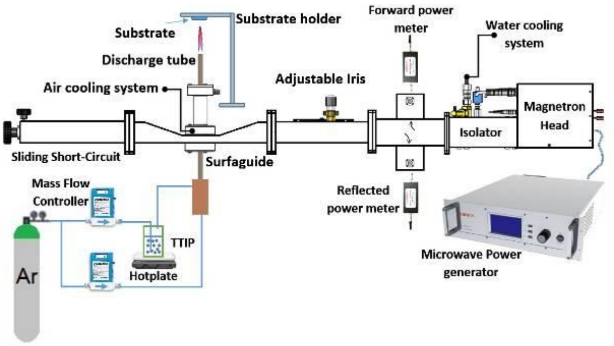

Fig. 1, Microwave plasma torch driven by surface wave

3. Results

For TiO_2 thin film synthesized on a quartz plate, Raman spectrum is shown in Fig. 2.

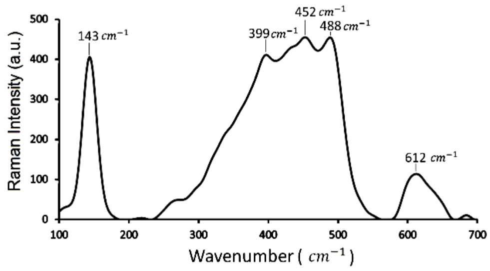

Fig. 2, Raman spectrum of anatase TiO_2 thin film

The bands shown at 143, 397, 452, 488, and 612 cm^{-1} characterize TiO_2 anatase phase formation. UV-VIS spectra for synthesized TiO_2 thin films on quartz substrate are measured taking air as reference at different deposition times. In Fig. 3, transmittance percentage in the UV spectrum in the range 200 to 400 nm, decreases as deposition time increases due to larger film thickness formed on substrate.

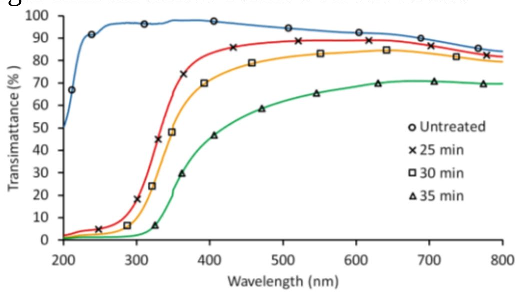

Fig. 3, UV-Vis transmission spectra for TiO_2 thin film

4. Conclusion

Synthesis of thin film porous nanostructure TiO_2 of appreciable thickness is obtained by atmospheric microwave torch at moderate power.

5. References

[1] Y. Gazal, C. Dublanche-Tixier, C. Chazelas, M. Colas, P. Carles, P. Tristant, Thin Solid Films, 600 (2016) 43–52