

# Influence of doping with carbon and nitrogen on photoactivity of TiO<sub>2</sub> thin films by PVD

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## Abstract

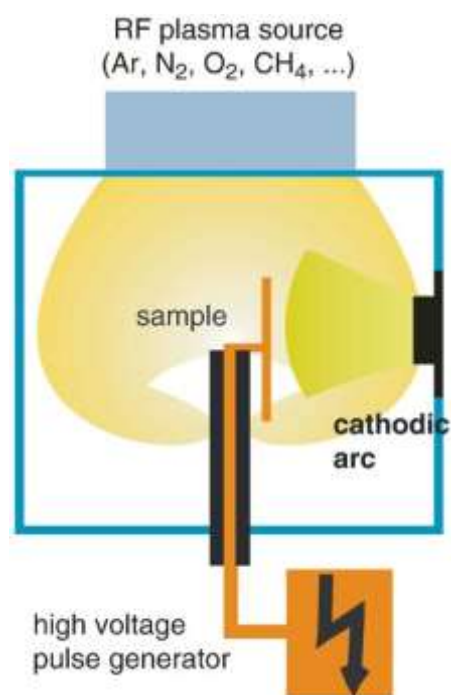
Titanium dioxide is well known as a photoactive material to be activated under ultraviolet irradiation and is either employed as a photocatalyst or exhibits superhydrophilic behavior after reducing the surface energy under illumination for self-cleaning or anti-fogging surfaces. For increasing the reactivity of the thin films under solar illumination, a reduced band gap is desired. Doping with transition metals or with nitrogen has been reported in the literature. However, the incorporation of nitrogen into the growing film, is a much more complex process which is presently not completely understood. TiO<sub>2</sub> thin layers were produced by metal plasma immersion ion implantation and deposition at room temperature at a pulse voltage of 0 to 5 kV and a duty cycle of 9 % for an apparently amorphous layer. An auxiliary rf plasma source was employed to increase the growth rate at low gas flow ratios. By adjusting the geometry between incident ion beam, sputter target and substrate, independently from the primary ion energy and species, a controlled deposition of samples was possible. Conventional ion implantation was employed to implant either carbon or nitrogen ions below the surface for bandgap engineering. The resulting thin films have subsequently been investigated for optical properties, stoichiometry, structural properties, surface topography and photoactivity.

## References

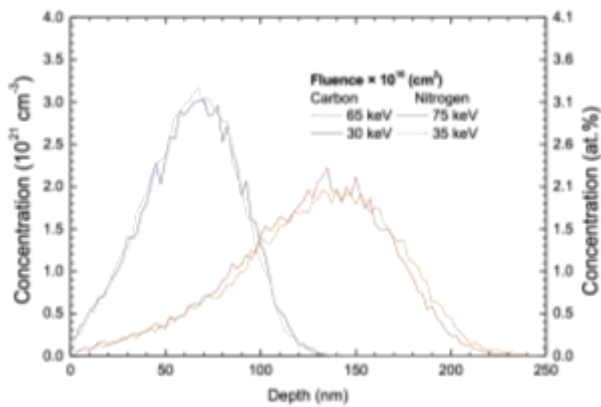
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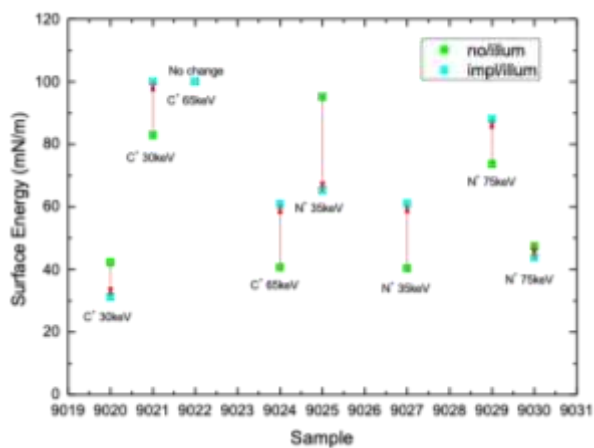
## Figures



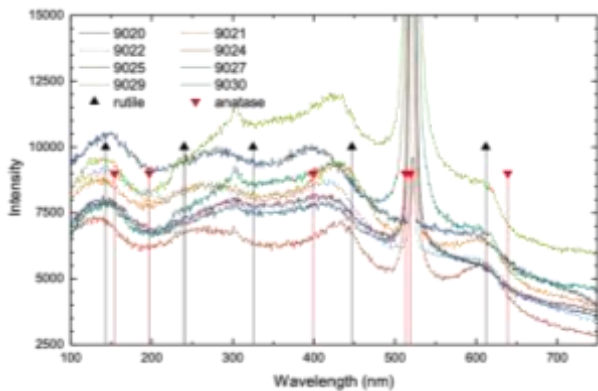
**Figure 1:** Schematic of the MePIID deposition system with auxiliary plasma source



**Figure 2:** Concentration profiles of Carbon and Nitrogen



**Figure 3:** Surface energy of selected samples before and after implantation with/without UV-illumination



**Figure 4:** Raman spectra of selected samples after implantation, together with reference spectra of a rutile thin film and anatase powder (APS 32 nm, Alfa-Aesar).<sup>17</sup> The prominent peak at 520  $\text{cm}^{-1}$  arises from the Si substrate

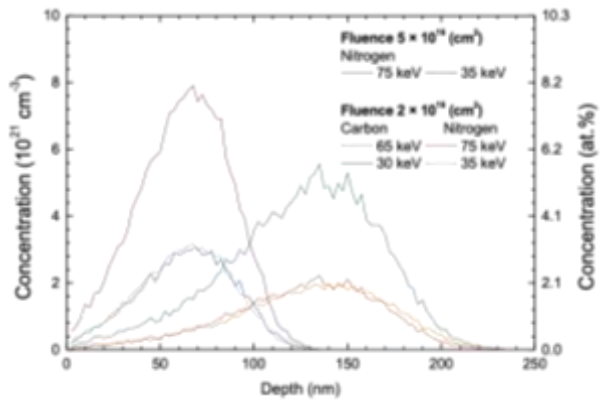


Figure 5: Concentration profiles of carbon and nitrogen by SRIM

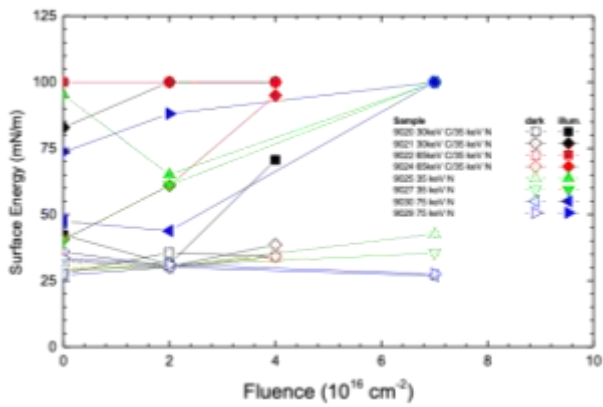


Figure 6: The variation of surface energy with ion fluency before and after illumination