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In-situ vacuum studies of photocatalytic oxidation of isopropanol on nanometer thick TiO_2 films grown on silicon D. KAZAZIS, Brown Univ, Providence, RI, S. GUHA[1], N.A. BOJARCZUK, IBM T.J. Watson Research Center, Yorktown Heights, NY, H.-C. KIM, IBM Almaden Research Center, San Jose, CA, A. ZASLAVSKY, Brown Univ, Providence, RI — We report on measurements of the photocatalytic activity of ultra-thin TiO_2 films grown on n and p type Si wafers. Using the oxidation of isopropanol to acetone as a model system, photocatalytic studies were carried out in-situ, in a high vacuum chamber equipped with leak valves for injecting isopropanol, oxygen and water vapor onto the TiO_2 sample. The sample was irradiated through a quartz widow with a UV strobe light source. The reaction was monitored with a line-of-sight mass spectrometer coupled to a lock-in amplifier tuned to the strobe frequency. We find that the photocatalytic efficiency is enhanced as the TiO_2 thickness is reduced from $50nm$ to $2nm$. We also find that the efficiency is enhanced by lowering the substrate Fermi level in going from n type to p type Si. The results strongly point to the hypothesis that only near surface electron-hole pair generation is relevant to the photocatalytic process; and that the reaction rate can be controlled by varying the substrate Fermi level which in turn changes the electrostatic potential variation within the heterostructure.

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