

# Ceramic Films from Aqueous Solutions: *Engineering the Substrate*

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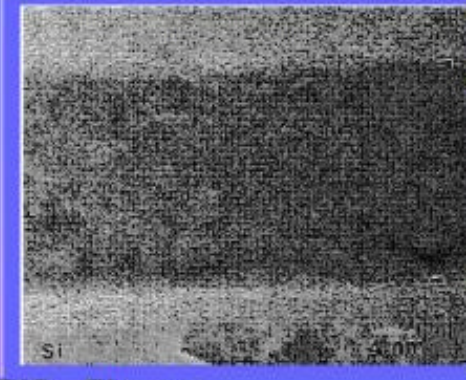
DMR 9803851

MSE at CWRU; collaborations w/MPI Stuttgart (Germany) & Bar Ilan Univ. (Israel)

- **Sulfonate** (-SO<sub>3</sub>H) surfaces →

- Strongly **negatively** charged  
(-SO<sub>3</sub>H → -SO<sub>3</sub><sup>-</sup> + H<sup>+</sup>)

- ⇒ nanocrystalline **TiO<sub>2</sub>**, **ZrO<sub>2</sub>**, **SnO<sub>2</sub>** films



25-nm  
TiO<sub>2</sub>  
film  
Si w/-SO<sub>3</sub>H  
surface

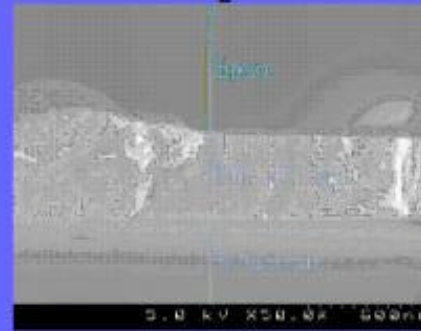
- **Amine** (-NH<sub>2</sub>) surfaces

- **Positively** charged →  
(-NH<sub>2</sub> + H<sub>2</sub>O → NH<sub>3</sub><sup>+</sup> + OH<sup>-</sup>)

- **Charge reversal**  
in ionic double layer

- ⇒ **TiO<sub>2</sub>** and **V<sub>2</sub>O<sub>5</sub>·nH<sub>2</sub>O** films

470-nm TiO<sub>2</sub> film on  
Si w/-NH<sub>2</sub> surface



- **Alkyl ammonium salt** (-NR<sub>3</sub><sup>+</sup>) surfaces

- Strongly **positively** charged

- ⇒ 80-μm thick **V<sub>2</sub>O<sub>5</sub>·nH<sub>2</sub>O** films



V<sub>2</sub>O<sub>5</sub>·nH<sub>2</sub>O  
films on Si  
with -NH<sub>2</sub>  
(above) and  
-NR<sub>3</sub><sup>+</sup> (left)  
surfaces