

Carbon accumulation and mitigation on model electron-irradiated TiO₂ capping layers: a comparison with Ru

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Outline

I. Electron-induced defect formation on $\text{TiO}_2(011)$

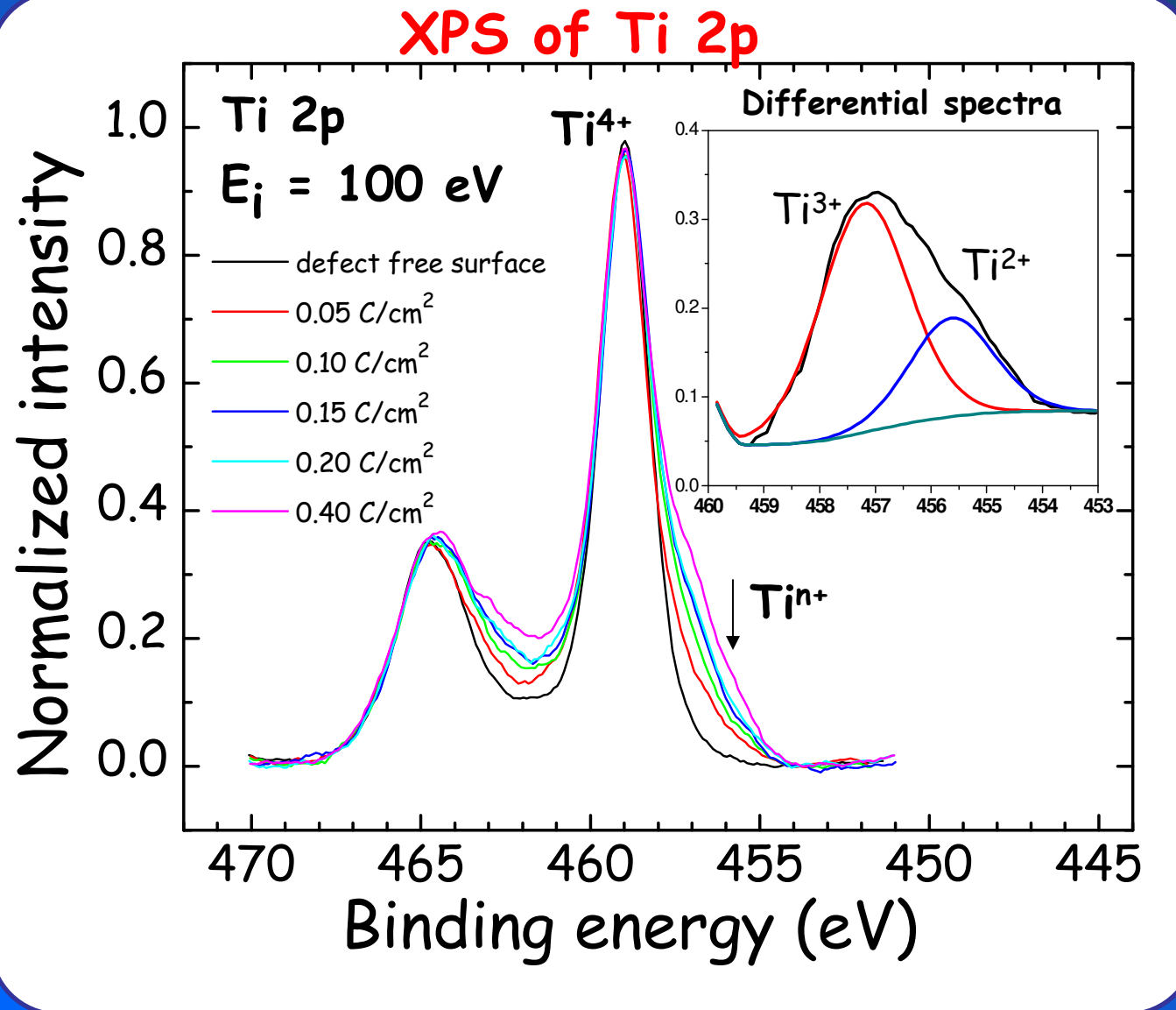
II. Carbon deposition upon irradiation in MMA vapor;
compare with C growth on Ru

III. Mitigation effects in $\text{O}_2 + \text{MMA}$

IV. Secondary electron yields (SEY) from TiO_2 MLM



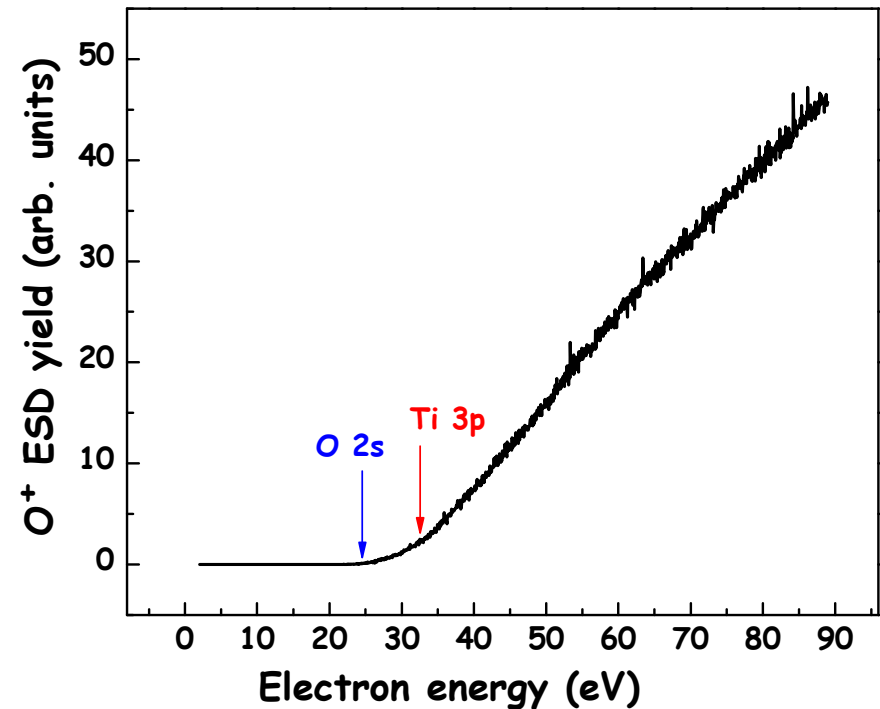
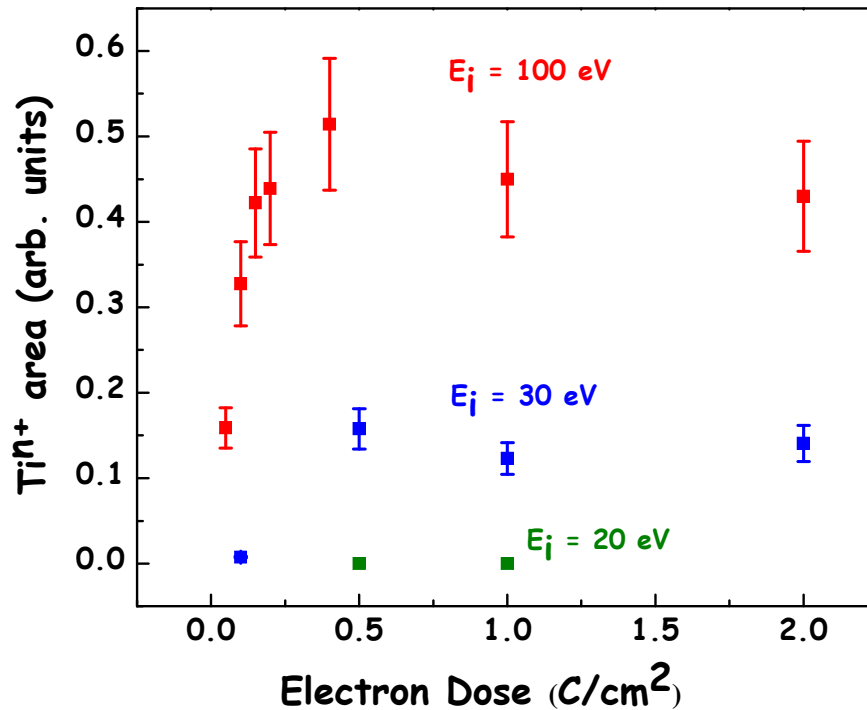
I. Electron irradiation induces defects on $\text{TiO}_2(011)$



Anion vacancy defects are produced by electron stimulated desorption of surface oxygen atoms.



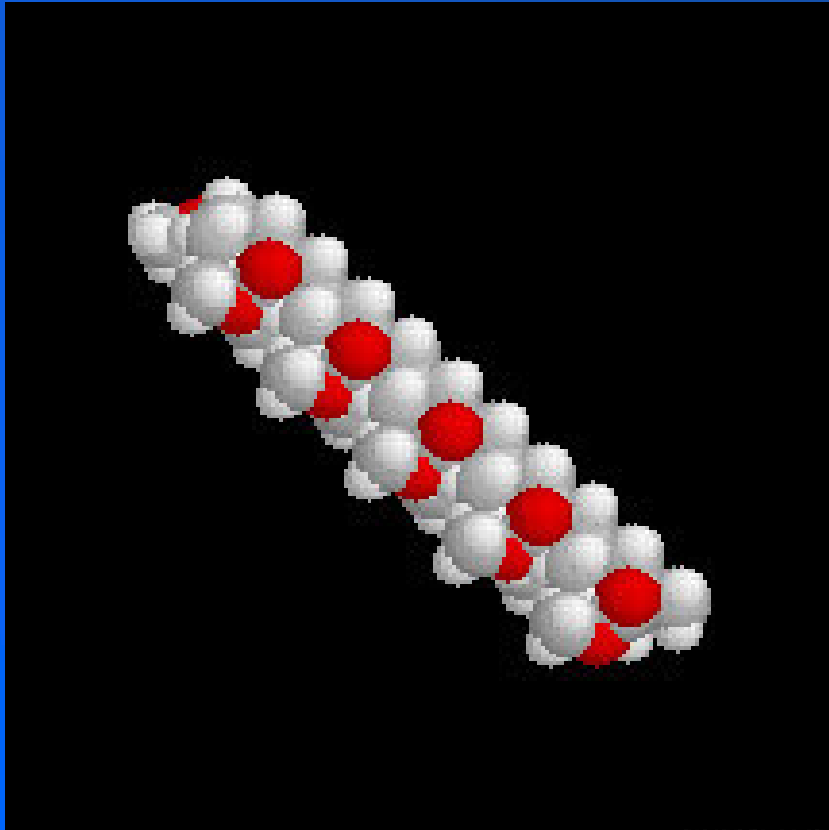
Electron irradiation induces defects on $\text{TiO}_2(011)$



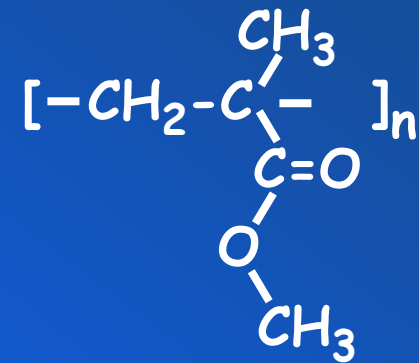
Electron energy $> 25 \text{ eV}$ leads to O vacancy formation on TiO_2 ; EUV photons do so also!



II. Methyl methacrylate (MMA), $C_5H_8O_2$

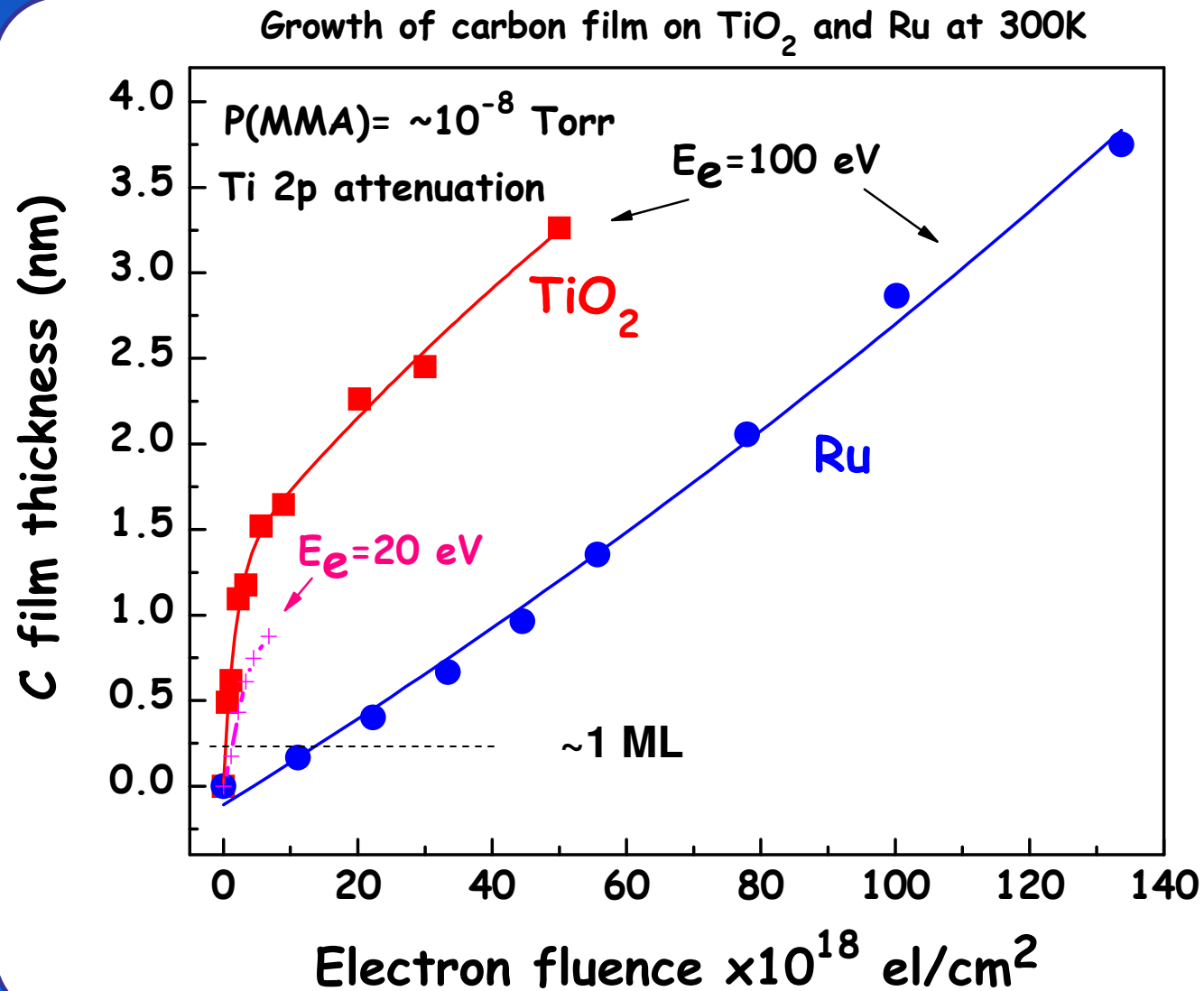


PMMA





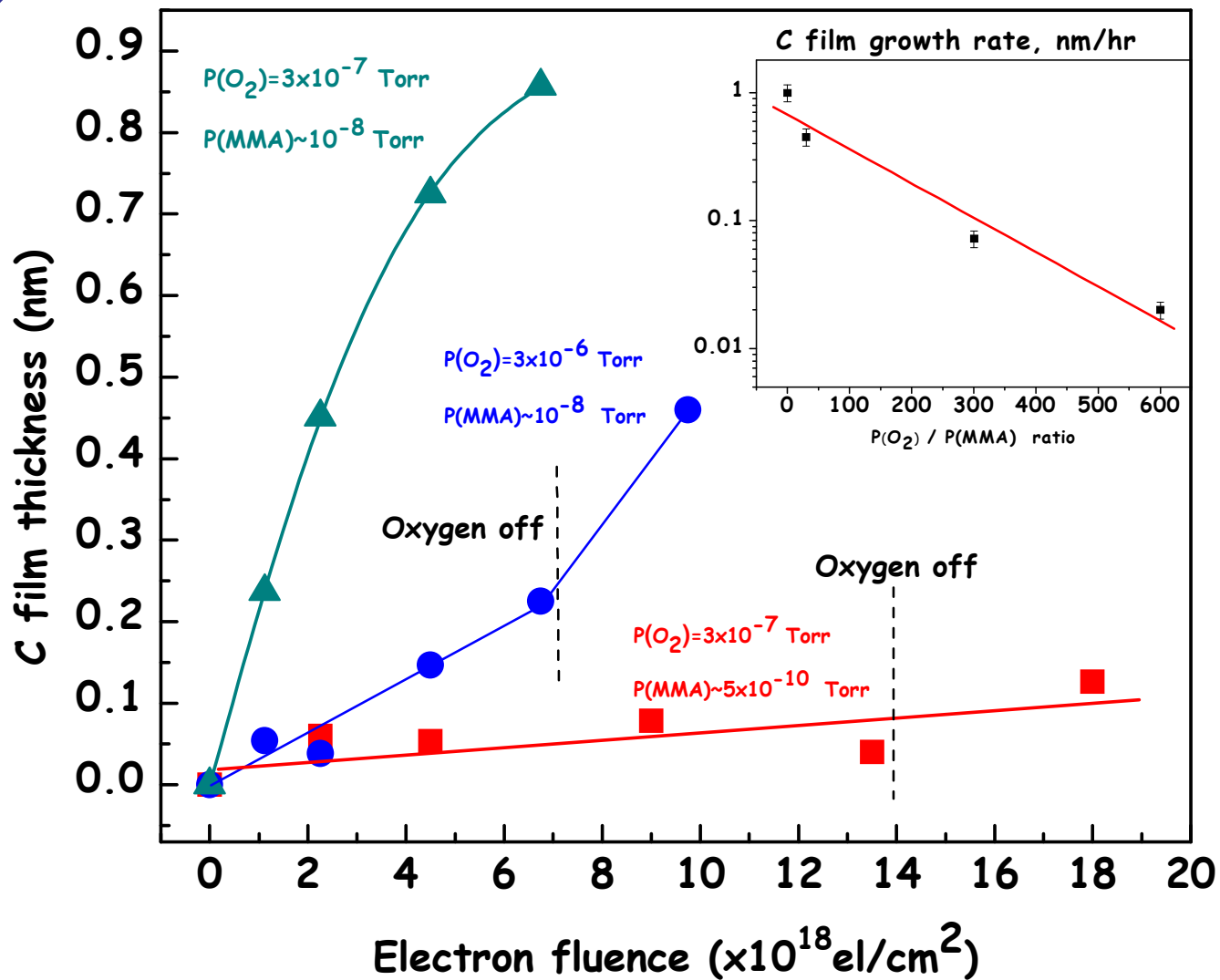
C growth under electron irradiation



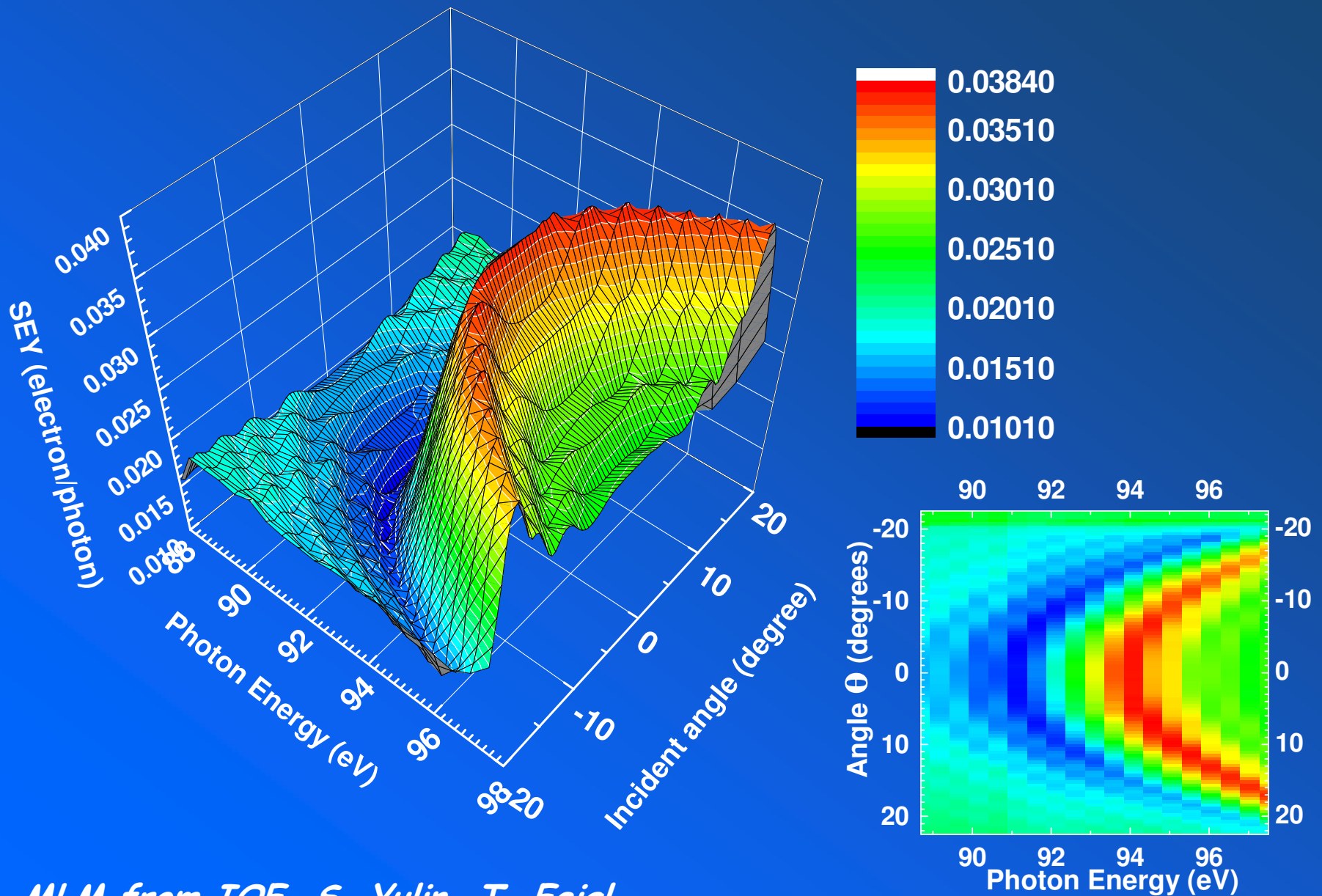
Initial C growth rate on $\text{TiO}_2 \gg$ than on Ru;
limiting C growth similar for thicker films



III. Mitigation effects for MMA/TiO₂, 300K (oxygen + electron-irradiation: 100μA, 100eV)



IV. Resonances in SEY from TiO_2 capped MLM ~ 13.5 nm



MLM from IOF, S. Yulin, T. Feigl



Summary

- Defects (O-vacancies) caused by electron energies > 25 eV
- Initial radiation-induced carbon accumulation faster on TiO_2 than on Ru
- Limiting C growth rates the same on Ru and TiO_2 , for C thickness > 1 to 1.5 nm
- Electron energies ~ 20 eV cause C growth on TiO_2 , so low energy secondaries are important; see resonances in MLMs
- Mitigation by irradiation of TiO_2 in MMA + high concentrations of O_2