Atomic-Layer Deposited Nb_2O_5: A Novel Passivating Contact Material?

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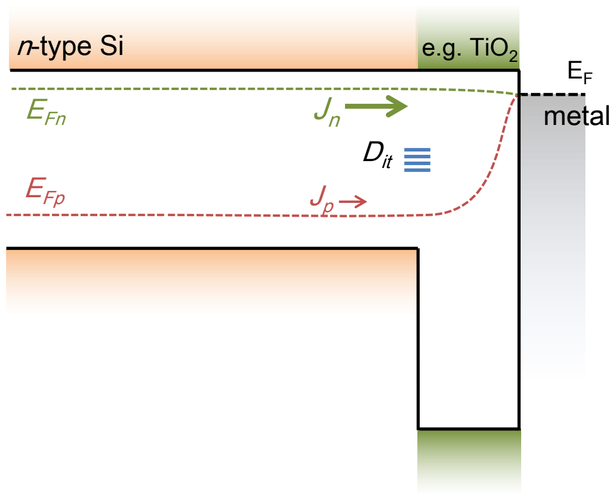
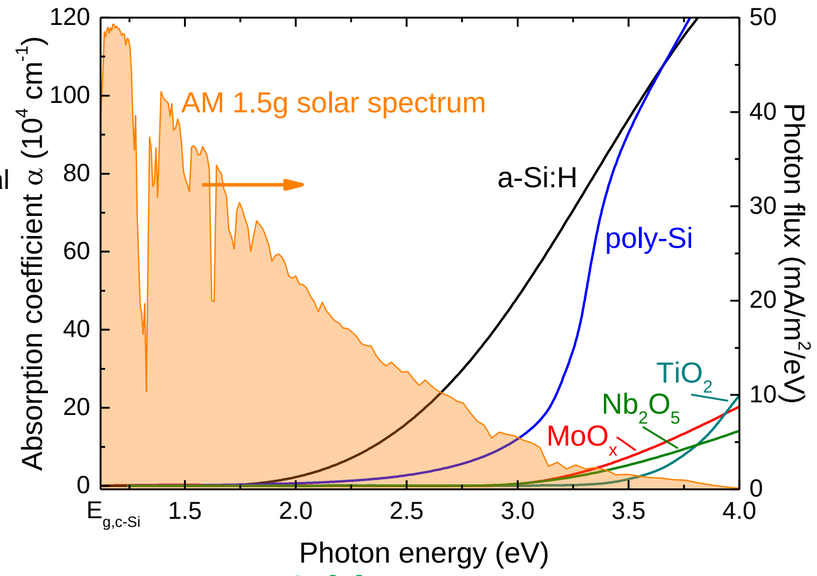
The idea: ALD Nb_2O_5 as e-selective contact:

- Should have similar band offsets as TiO_2
- More thermally stable?

Used n-type FZ wafers as substrate, either:

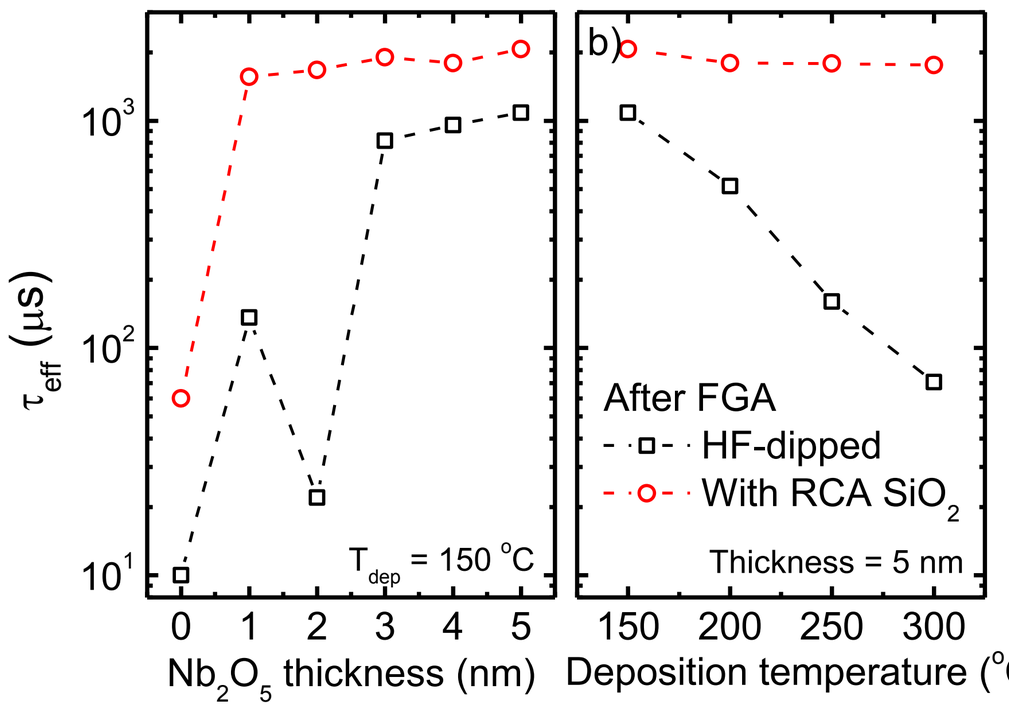
- HF dipped prior to ALD Nb_2O_5
- With RCA-grown SiO_2





Highly transparent

Passivation results:

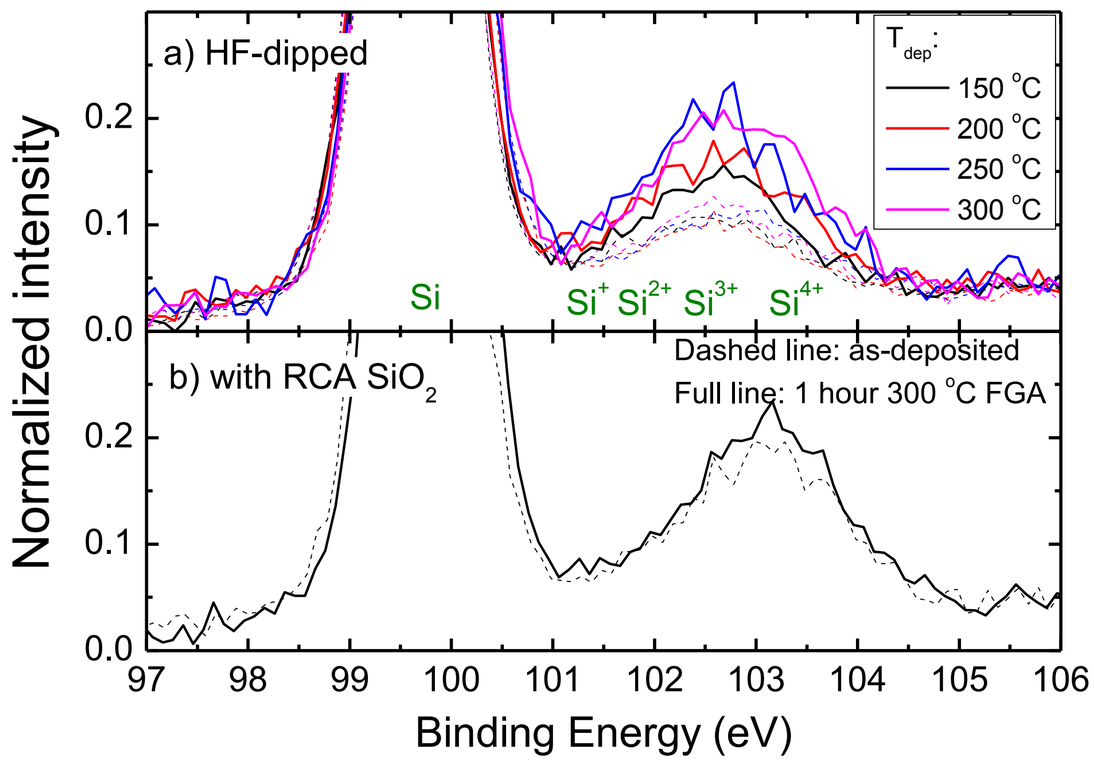


Good passivation on both surfaces, but for RCA:

- Better passivation
- Lower sensitivity to T_{dep} and thickness
- Good passivation for only 1 nm!

Chemical passivation:

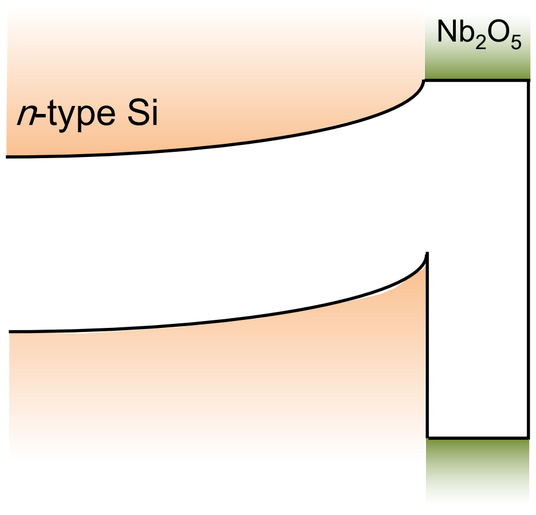
Investigated oxidation state of interfacial oxide by XPS



On HF-dipped: Oxide grows upon FGA, depends on T_{dep}

On RCA SiO_2: Oxide is more stoichiometric and independent of T_{dep} and annealing

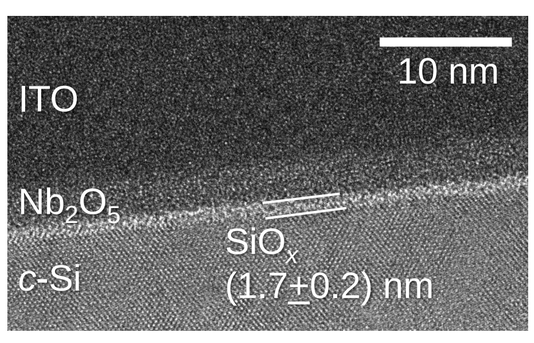
Field-effect passivation:



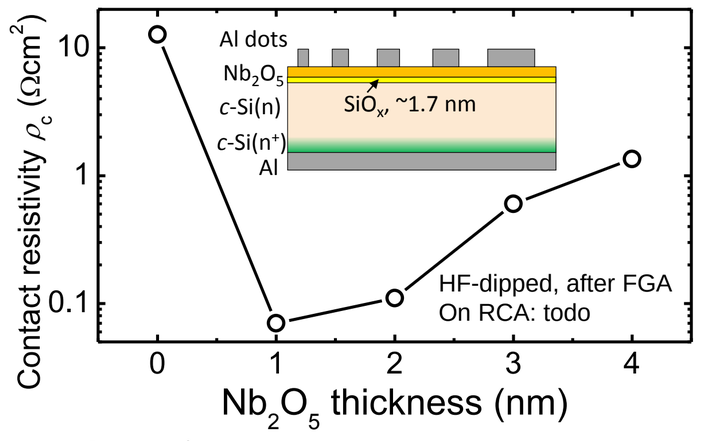
SPV measurements:

- ~850 mV upward on both HF/RCA
- This would imply hole-selectivity!
- Although this is also observed for TiO_2 ➔ influence metal?

TEM and contact resistance:



HF-dipped, after FGA



Good ρ_c on n-type structure!

Al contact negates upward band bending?

Conclusions:

- ALD Nb_2O_5 enables good passivation (champion J_0 13 fA/cm^2)
- Presence of RCA oxide improves passivation and enables use of thinner Nb_2O_5
- Even though Nb_2O_5 induces a very stong upward band bending, a good *n*-type contact can be formed!
- **Next steps**: Check selectivity: J0 after metal? + solar cell implementation!

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