Oxidation of Mg films monitored with Mg/p-Si(111) Schottky diodes

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Principle of chemicurrents

- Non-adiabatic dissipation of chemical reaction energy
- Hot charge carrier detection with thin metal film
- Schottky diodes: hot electrons → n-type diodes
- Hot holes → p-type diodes
- Schottky barrier height $\Phi(Si) = 0.5 - 1$ eV

Exoemission and chemiluminescence with O$_2$ → Mg

- Deposited energy: $\approx 2.4$ eV/molecule
- Chemiluminescence (CL) and exo-electron emission (EE)
- Work function ($\Phi$) reduction with O coverage
- Open question: CL and EE transients due to $\Phi$ variation??

Chemicurrents in Mg/p-Si Schottky diodes during O$_2$ exposure

- Evidence of surface chemiluminescence with type I diodes
- Exponential attenuation
- Larger attenuation constants with type II diodes

Diode properties from I-V curves:
- Type I: inhomogeneous
  - Ideal factor $n = 1.4 - 2.7$
  - Effect barrier $\Phi_0 = 0.6 - 0.87 = 0.66 - 0.76$ eV
  - Homog. barrier $\Phi_{bar} = 0.8$ eV
- Type II: homogeneous
  - Effect barrier $\Phi_0 = 0.72$ eV
  - Homog. barrier $\Phi_{bar} = 0.7$ eV

Spectroscopy of hot charge carriers

- Three-step model:
  - Particle
  - D: Hot hole distribution
  - A: Attenuation
  - T: Transmission

Kinetics

- Oxygen coverage proportional to detected charge in the diode:

Conclusions

- Chemicurrent method much more sensitive than exoelectron emission
- Efficient correlated to diode preparation and homogeneous Schottky barrier height
- No work function affect! Chemisistant transient with maximum exclusively related to chemical reaction kinetics
- Reaction rate increases with O coverage in the low-coverage regime