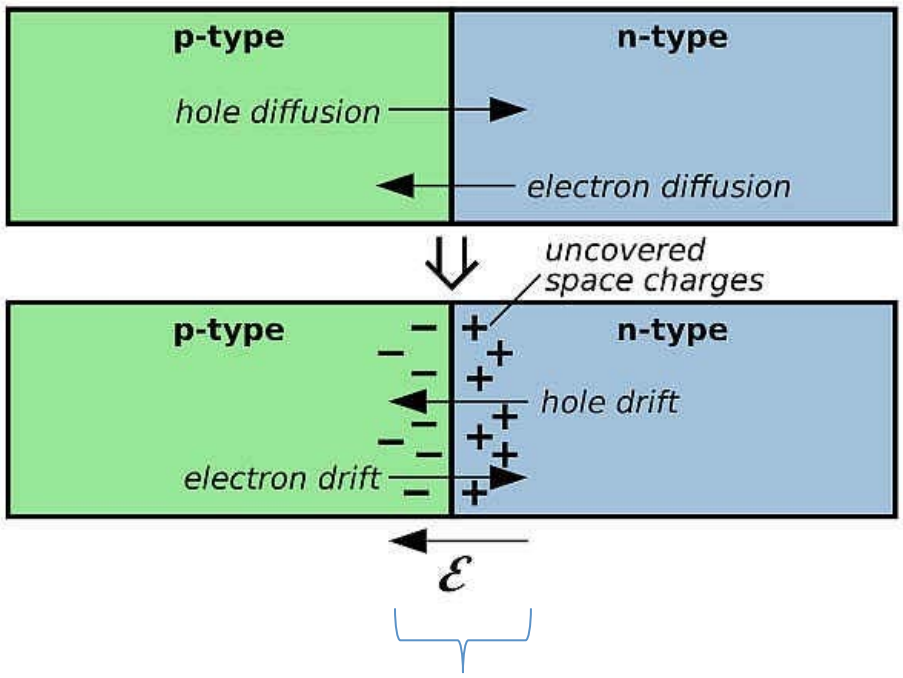
Lab #11 Silicon PV

How PN Junction Works



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Dopant atoms that are left behind are charged, creating a localized electric field

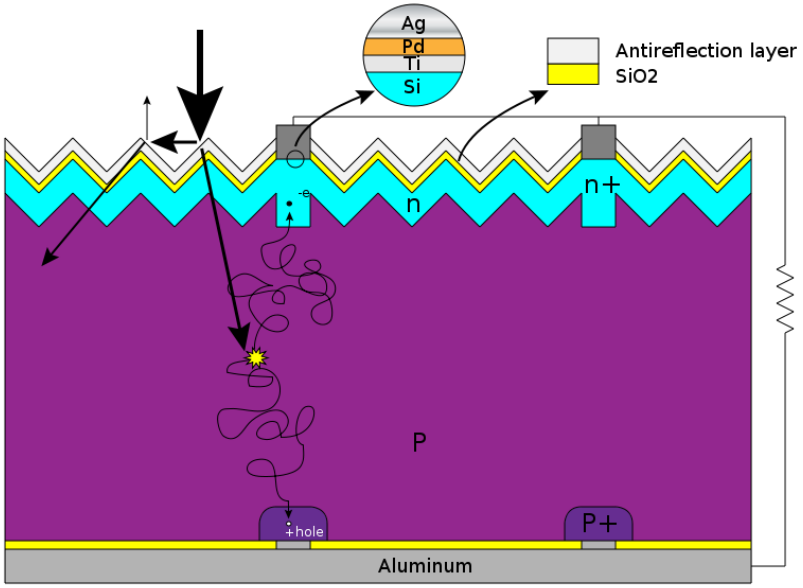


Image courtesy of Cyferz at en.wikipedia.

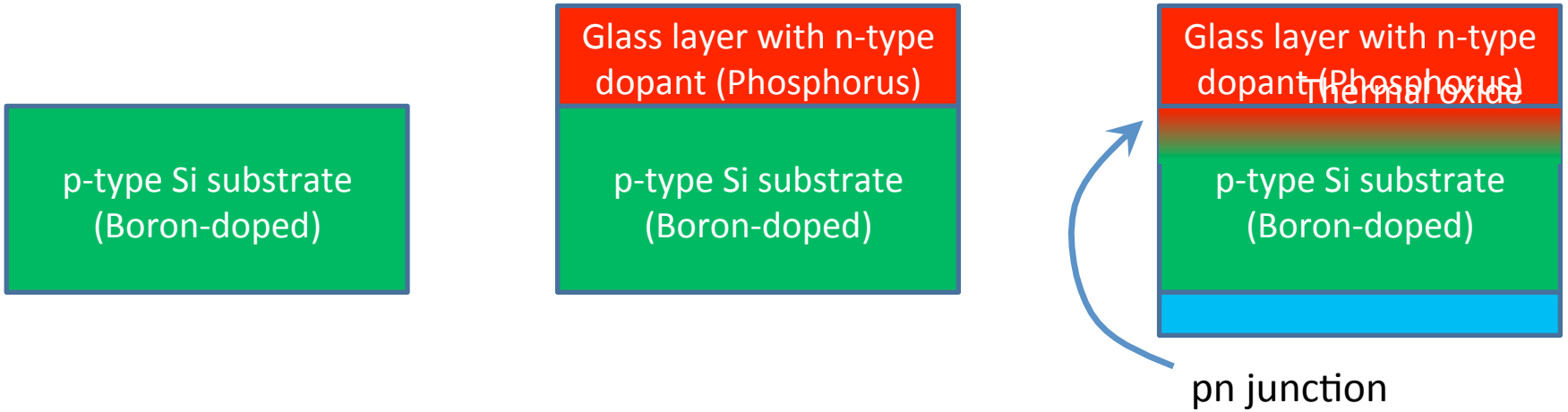
Basic structure of a silicon based solar cell and its working mechanism.

Si Solar Cell Fabrication Process

1) Start with p-type Si wafer (Boron incorporated during growth)

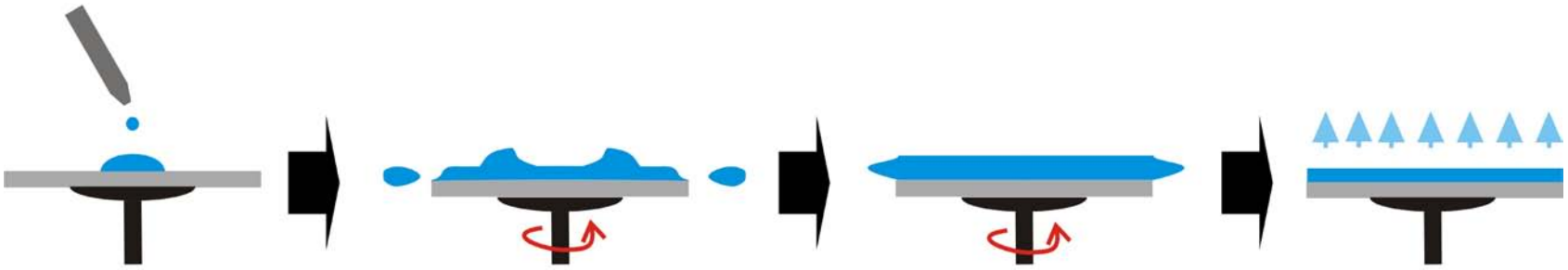
2) Spin-on n-type dopant (Phosphorus/glass mix)

3) Diffuse n-type dopant into substrate at high temperature (1000C) for 1.5 hours



Spin Coating

$$h = \frac{h_0}{\left(1 + \frac{4\rho\omega^2 h_0^2 t}{3\eta}\right)^{\frac{1}{2}}}$$



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- Apply uniform thin films to flat substrates by spreading the fluid with centrifugal force
  - The higher the angular speed, the thinner the film
  - The more viscous a solution, the thicker the film

SiO_2 Color Chart

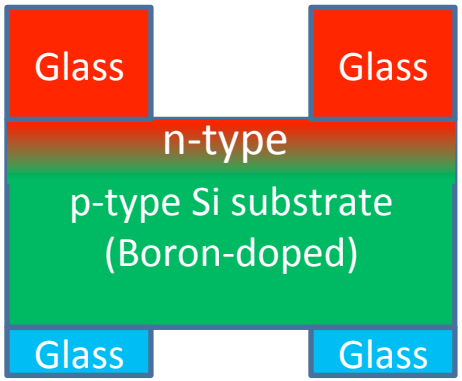
Color chart removed due to copyright restrictions.
Refer to: Oxide Thickness Color Chart from ECE Illinois.

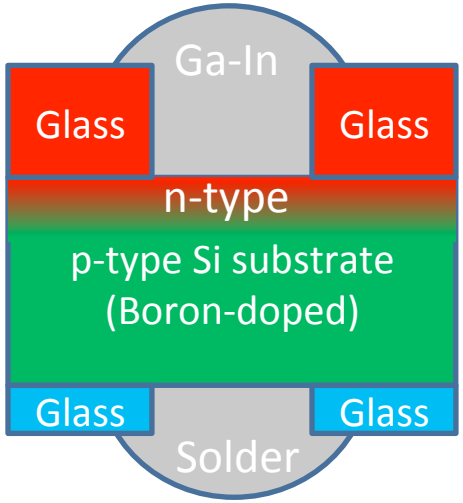
Si Solar Cell Fabrication Process

4) Remove glass dopant and thermal oxide layers using glass etchant cream

5) Metallize the front and back

6) Test!!!!



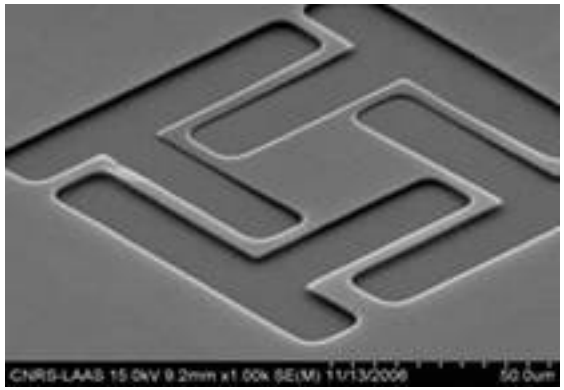


Note: if we're careful about the thickness of our spin-on glass, we can use it as an AR coating

SiO_2 Etching

Frequently aqueous hydrofluoric acid (HF) solutions are used as SiO2 etchants.

SiO_2 (s) + 4HF (aq) –> SiF_4(g) + $2H_20$



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I. Protons are adsorbed to oxygen on the surface featuring the strongest basicity which functions as the proton accepter.
II. Oxygen which adsorbs the proton needs the valence electron.
III. Oxygen obtains the valence electron from neighboring silicon which has many electrons.
IV. As silicon gives the valence electron to oxygen, the electron density around silicon gets lower. Consequently the silicon-oxygen bond gets weaker, and the bond is eventually broken.
V. When the silicon-oxygen bond is broken, silicon becomes positive.
VI. As a result, HF_2^- is coordinated to facilitate etching.

IV Characterization

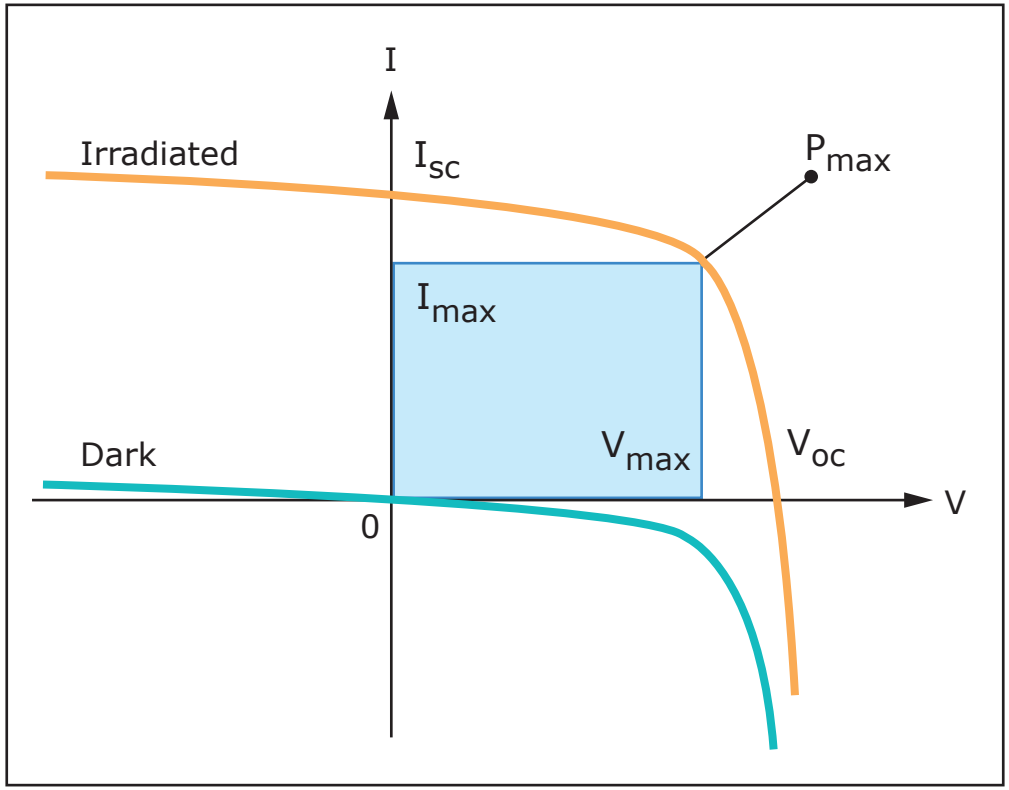

Image by MIT OpenCourseWare.

6.S079 Nanomaker

Spring 2013