HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

JÜLICH Forschungszentrum

Research Unit:

Photovoltaics (IEK-5)

Program:
Renewable Energies

Topic:
Solar Cells of the Next Generation

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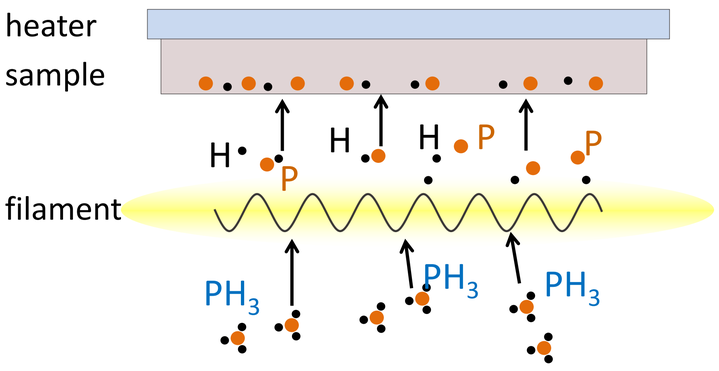
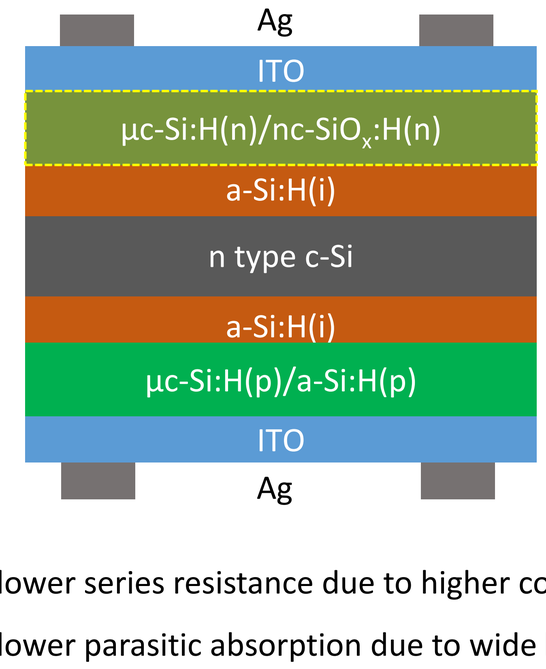
Post-deposition catalytic doping integrated into the fabrication of silicon heterojunction solar cell

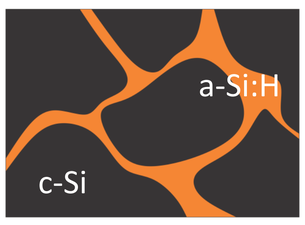
Cat-doping apparatus



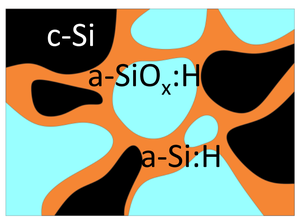
- Low substrate temperature
- shallow doping depth
- no ion damage
- compatible with SHJ solar cells fabrication

Silicon alloys for SHJ solar cell





µc-Si:H(n)

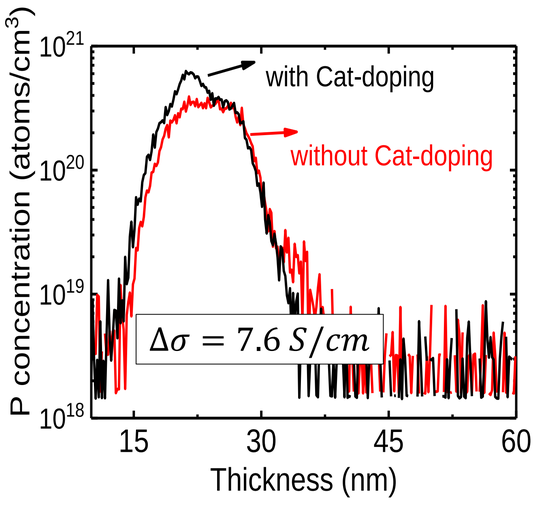


nc-SiO_x:H(n)

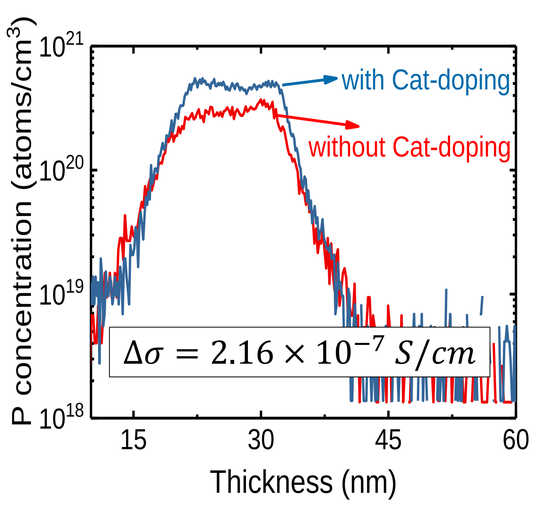
- lower series resistance due to higher conductivity of µc-Si:H(n)
- lower parasitic absorption due to wide bandgap of nc-SiOx:H(n)

Materials properties

µc-Si:H(n)

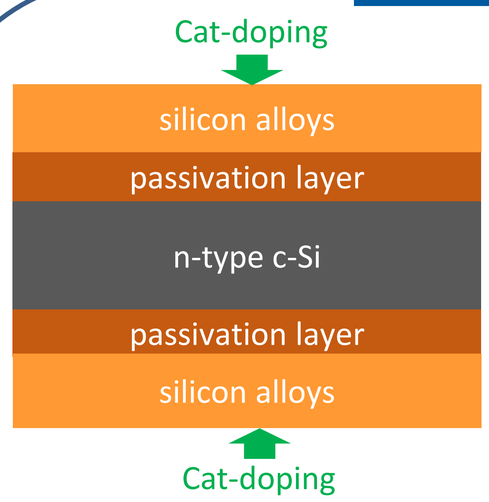


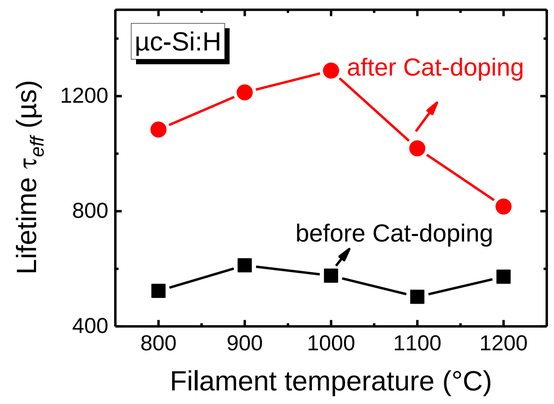
nc-SiOx:H(n)

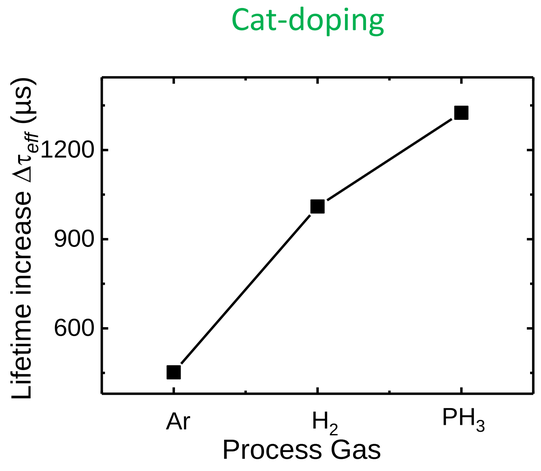


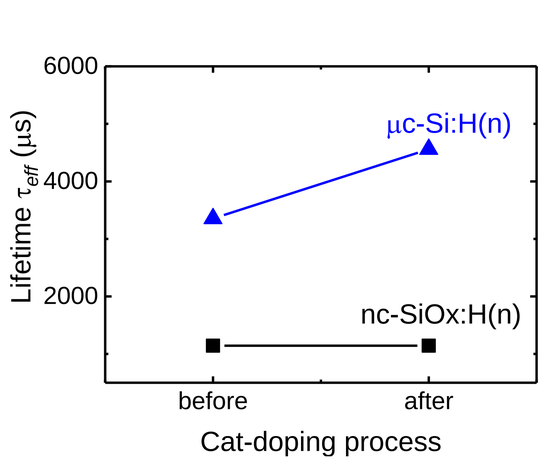
- Cat-doping can further dope silicon alloy films for several nanometers and increase the conductivity

Stack performance





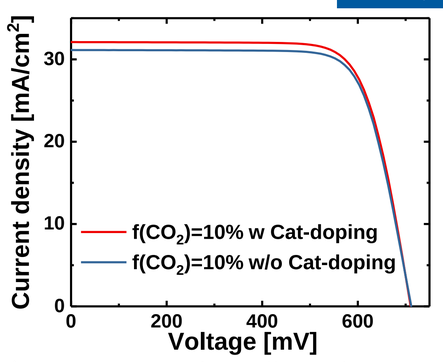


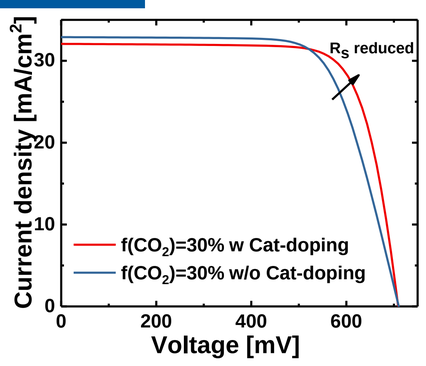


Possible effects during the Cat-doping process:

- Thermal annealing
- H atoms passivation
- Field effect passivation

Cell performance





❖ 2cm X 2cm solar cell on planar FZ wafer

Sample ID	Voc [mV]	Active area Jsc [mA/cm²]	Active area Eff [%]	FF [%]
f(CO2)=10%	712	34.6	18.7	75.8
f(CO2)=10% w/ Cat-doping	711	34.5	18.5	75.4
f(CO2)=30%	710	34.8	17.4	70.6
f(CO2)=30% w/ Cat-doping	709	34.9	18.8	76.0

+5.4%

- Cat-doping works more efficient for materials with lower doping

Conclusion

- Cat-doping increases conductivity of silicon alloys
- Shallow doping into silicon alloys proven by SIMS measurement
- Cat-doping can potentially increase lifetime of stack using silicon alloys
- Cat-doping is promising to improve device performance with silicon alloys