# Detailed Accounting for Quantum Efficiency and Optical Losses in a-Si:H based Solar Cells

Light scattering in amorphous silicon (a-Si:H) based thin-film solar cells on glass/ZnO substrates is applied to enhance the quantum efficiency by both improved light input and light trapping. The surface texture of the chemically etched ZnO films was varied over a wide range in haze levels, while the film thickness was kept constant. Thus the enhancement of quantum efficiency and cell current can be attributed solely to light scattering due to haze and adequate surface texture, independently of the film absorbance. The current enhancements reach 25 % at haze values of about 20 %, and then tend to saturate. The difference between the effective transmission of the TCO and the quantum efficiency represents the optical losses which are individually accounted for *(Fig. 1)*.

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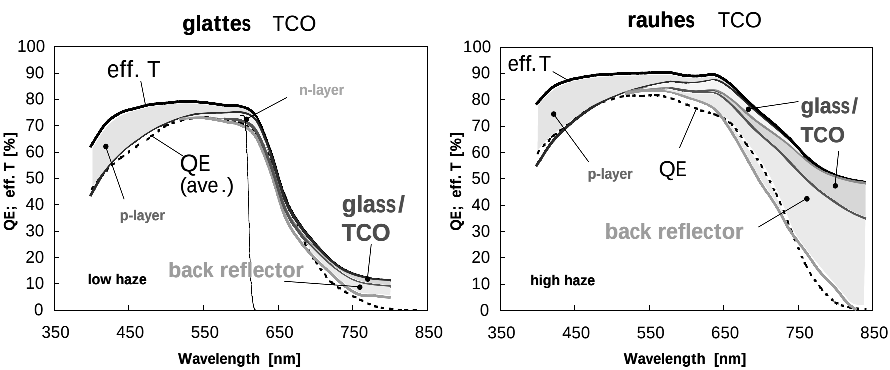


*Figure 1*

*Effective transmission, quantum efficiency and optical loss contributions for a-Si:H solar cells deposited on TCO of low and high haze.*

For wavelengths up to 600 nm, the current enhancement is fully explainable by the reduction of the cell reflectivity due to index-grading of the textured TCO/p interface. For the long-wavelength range of 600 to 750 nm, the current enhancements are additionally determined by light trapping, but fall short of the increase to be expected from the reduced reflectivity. This can be explained by additional optical losses due to increased absorbance in the non-photoactive layers and multiple reflections at the back reflector.