Stability of AlN as interlayer for CIGSe/Si tandem cells

K. Ozeir[1,2], T. Lepetit[1], A. Barbier-Cueil[3], F. Semond[3], O. Durand[2] and N. Barreau[1]

[1] Nantes Université, IMN, CNRS, Institut des Matériaux de Nantes Jean Rouxel, Nantes, France
[2] Univ Rennes, INSA Rennes, CNRS, Institut FOTON - UMR 6082 Rennes F-35000, France
[3] Université Côte d'Azur, CNRS, CRHEA, UMR 7073, Sophia-Antipolis, France

Silicon-based tandem cells are among the most promising technologies for renewable electricity production using high-efficiency, low-cost photovoltaic cells. For this reason, these devices are the subject of intensive research within the scientific community.

The combination of copper indium gallium selenide (CIGS) with silicon has attracted attention due to the complementary absorption profiles of the two materials. In theory, CIGS/Si tandem structures can enable efficient use of the solar spectrum. However, experimental integration of CIGS directly onto silicon substrates is challenging. The main issues concern the poor adhesion of the CIGS absorber layer to the silicon surface, as well as the potential diffusion of copper into the silicon during growth or post-deposition treatments. This copper contamination can degrade the electrical properties of the silicon bottom cell, ultimately hindering device performance and long-term stability.

To address these issues, our research is focused on the development and integration of suitable interlayers that can act as both diffusion barriers and buffer layers to improve adhesion as shown in the figure 1. In this context, III-V semiconductors have shown great promise due to their tunable properties and compatibility with both CIGS and silicon. Our current investigation is centered on aluminum nitride (AlN), a wide-bandgap III-V compound known for its chemical stability, thermal resistance, and excellent diffusion-barrier properties.

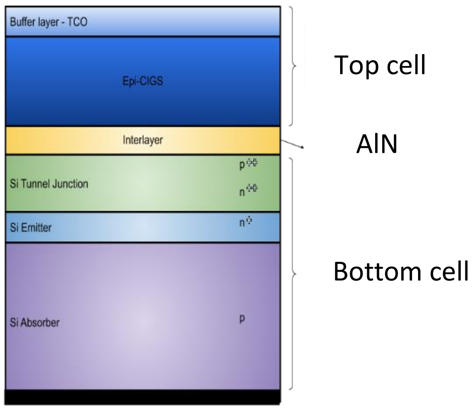

Figure 1 Schematic representation of the studied structure

The objective of this contribution is to study the structural and chemical stability of AlN when exposed to copper and S/Se fluxes during typical CIGS deposition conditions. By simulating the growth environment and analyzing the resulting material interfaces, we aim to evaluate whether AlN can effectively prevent copper diffusion into the silicon substrate while maintaining interface integrity. This work represents a crucial step to the realization of high-efficiency, stable, and adaptable CIGS/Si tandem solar cells. This work is supported by the PEPR TASE-IOTA project.