$Al_{5+\alpha}Si_{5+\delta}N_{12}$, a new Nitride semiconductor

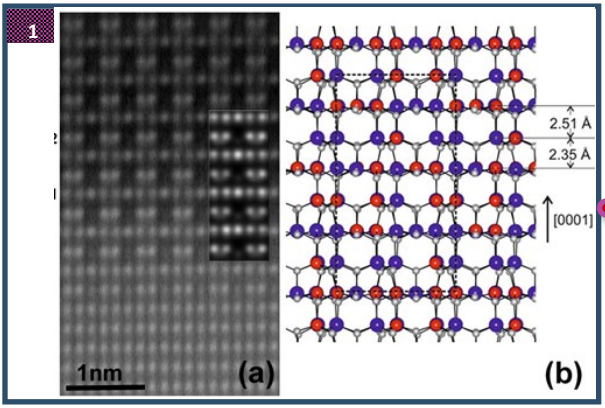

Fig 1: (a) High resolution high angle annular dark field image of a $Al_{5+\alpha}Si_{5+\delta}N_{12}$ layer epitaxied on AlN. The insert shows a simulated image using the model presented in (b).

(b) Schematic representation of the structural model of $Al_{5+\alpha}Si_{5+\delta}N_{12}$ relaxed by DFT calculations. Large red and blue spheres denote Si and Al atoms,

New material, new properties?

A new semiconductor, $Al_{5+\alpha}Si_{5+\delta}N_{12}$, was synthesized by high temperature annealing of aluminum nitride films under silicon flux. A high resolution transmission electron microscopy study combined with theoretical calculations allowed to determine the crystalline structure of this new material. This structure is derived from the AlN parent one with the anion sublattice fully occupied by N-atoms whereas the cation sublattice is
the stacking of 2 different planes along <0001>: The first one exhibits a ×3 periodicity along <11–20> with 1/3 of the sites being vacant. The rest of the sites in the cation sublattice are occupied by an equal number of Si and Al atoms. The calculated band structure shows that $Al_{5+\alpha}Si_{5+\delta}N_{12}$ has a gap around 4 eV and suggests that this new semiconductor may have applications for the emission and detection of UV light as well as for the realization of normally-off transistors

Breakthroughs

A new semiconductor has been synthetized which opens the way to new properties and new applications

Perspectives

The next step of the study will be the synthesis of thicker $Al_{5+\alpha}Si_{5+\delta}N_{12}$ layers by annealing and growth processes to study their properties and envisage applications.

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