Cu-doped AlN: a spingaligner at room-temperature grown by molecular beam epitaxy

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Group-III nitride semiconductors cover a large bandgap-area and have good thermal and chemical stability. They are therefore interesting for many optoelectronic applications and devices. Especially nitride based spintronic is an emerging field of interest. One reason for this strong interest is the long, temperature independent spin-lifetime in InN quantum dots. The crucial point for spin-injection is a ferromagnetic layer which should show ferromagnetism far above room-temperature and a high spinpolarization. Diluted magnetic semiconductors (DMS) are the most promising candidates for a ferromagnetic layer. DMS exhibit ferromagnetism by substituting a little amount of group-III elements by transition metals. A magnetic material as dopant tends to build cluster in the semiconductor host. These clusters could show also ferromagnetism and the origin for the ferromagnetism in the hole DMS doped with magnetic materials will be unclear. For this reason a non-magnetic dopant is required. A promising candidate is Copper. Theoretical predictions suggest for Cu-doped AlN and Cu-doped GaN a maximal spinpolarization of 100% and a high Curie-temperature above 350 K. [2, 3] Only a few experiments have indicated ferromagnetism in both materials.

We investigated the growth of Cu-doped AlN by plasma assisted molecular beam epitaxy on c-plane sapphire substrates. The nominal doping level of Cu was varied up to Cu to Al ratio of 10%. All Cu-doped films show ferromagnetic behaviour far above room-temperature. The influences of the growth parameters such as substrate temperature or metal to nitrogen flux ratio on the magnetic and structural properties were determined.

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