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Recent advances in materials technologies of light alloys with controlled microstructures

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High performance light alloys have become more and more attractive for the wide appreciations such as automotive vehicles, rapid transportation trains, aircraft and aerospace materials. It is, therefore, greatly required to improve alloy properties, e.g. mechanical strength and ductility. To achieve the various requirements for the alloys the control of alloy compositions and optimized processing is essentially important. In this paper, recent advances in the alloy designing, fabrication processes and microstructural analyses for the wrought and cast aluminum and magnesium alloys are presented. Especially, the nanostructure control and analyses in the atomic scale are introduced.

Keywords: Aluminum alloys, Magnesium alloys, Microstructures, Nanoclusters, Bake Semi-solid forming

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Non-polar a-plane wurtzite nitride thin films grown on Si(100): An approach to eliminate the polarization effect

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III-nitride semiconductors attract interest as the most promising materials for optoelectronic devices covering the region infrared to ultraviolet. In the past, wurtzite III-nitrides growth was focused on c-axis oriented-film using substrates of polar-plane crystal with hexagonal symmetry, e.g., c-sapphire and 6H-SiC. However, nitride-based devices employ heterostructures grown along the polar [0001]direction, resulting in the formation of strong electrostatic fields, parallel to the growth direction due to the formation of fixed sheet charges at the corresponding interfaces or surfaces. Practically, the spontaneous and piezoelectric polarization effect in c-axis III-nitride quantum wells tends to modify the band structure, which causes a red-shift in its light emission. This phenomenon is due to charge separation of electron-hole pairs by internal electrical field. A method to eliminate the polarization effect is to grow the related-GaN compounds on non-polar plane substrates.

We fabricated III-nitride films on Si(100) substrates by pulsed laser deposition (PLD). We successfully obtained non-polar a-plane III-nitride films on Si substrate using special buffer layer of rock-salt structure.

Details of the film growth and of their optical properties will be discussed.

The non-polar plane GaN, which is free from polarization effect by controlling the growth plane, is expected to promote the fabrication of III-nitride based optoelectronic devices on silicon.

Keywords: GaN, Non-polar plane, buffer layer, Si