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Abstract for E-MRS 2019, Symposium X: Silicon carbide and related materials for energy saving applications

Fluorescent silicon carbide for white light source

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The technology breakthrough in high-efficiency blue nitride based LEDs has enabled the rapid market penetration of energy-saving LED white light sources. In this presentation, silicon carbide (SiC) has been explored to emit yellow light and blue light as a new wavelength conversion material for a new type of white LED light source taking advantages of abundancy and good thermal conductivity of SiC. Strong yellow emission from boron and nitrogen co-doped SiC has been demonstrated at room temperature. Blue emission has been investigated from both aluminum and nitrogen co-doping of SiC and porous SiC. Strong blue emission from Al-N co-doped SiC has only been observed at low temperature, while strong blue emission from porous SiC has been achieved at room temperature after optimization of pores formation conditions and surface passivation. White light with color rendering index as high as 81 has been achieved from B-N co-doped SiC with a porous surface under optical pump. A prototype of hybridly integrated warm white is achieved by adhesive bonding of a blue LED on SiC substrate with B-N co-doped fluorescent SiC. At last, a monolithically integrated warm white light source through directly growing near ultraviolet LED on fluorescent SiC by metalorganic vapor chemical vapor deposition is demonstrated. Our original results cover growth of fluorescent SiC, formation of porous SiC, optical characterization of these materials with regard to photoluminescence, low temperature photoluminescence, time resolved photoluminescence and thermally stimulated luminescence, material emission mechanism analysis, carrier dynamics analysis, warm white light source fabrication and characterization. Basing on these results, perspectives are shared.