CHEMICALLY DEPOSITED MULTILAYER SELECTIVE SURFACES

By

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ABSTRACT

Usefulness of the chemical deposition techniques, in particular the solution growth process, has been successfully demonstrated for the fabrication of multi-layer interference stacks and composite layers that can be used as selective absorbers.

Deposition of PbS, CdS, PbSe, CdSe and $(PbS)_{1-x}$-$(CdS)_x$ composite thin films on nickel coated copper and stainless steel and glass substrates, has been carried out using solution growth technique. Multiple layers have been deposited by successive dipping of the substrates in appropriate bath. Spray pyrolysis technique has been used to deposit SnO_2 and ZnO films.

Vacuum calorimetric, heat balance, radiometric set-ups and an integrating sphere have been designed and fabricated to evaluate selective surfaces.

Optical constants (n, k) of solution growth CdS, PbS, PbSe, CdSe and $(PbS)_{1-x}$-$(CdS)_x$ films have been determined using R and T data and then used in designing of selective surfaces. All the binary semiconductors exhibit properties of direct band gap material.

Absorptance of multilayer selective surface stacks of Ni/CdS/PbS, Ni/PbS/CdS, Ni/PbSe/CdSe, Ni/PbS/SnO_2, and Ni/PbS/ZnO, has been optimized using matrix multiplication method. These systems have been deposited according to optimized conditions using solution growth/spray

pyrolysis techniques. Selective absorber combinations of Ni/PbS/CdS, Ni/PbSe/CdSe, Ni/PbS/SnO_2, Ni/PbS/ZnO and Ni/$(PbS)_{1-x}$-$(CdS)_x$ with α values 0.92, 0.87, 0.93, 0.92, 0.90 and ε_{100} values of 0.12, 0.15, 0.16, 0.17, 0.1, respectively, have been obtained.

All coatings, except Ni/PbSe/CdSe, show no sign of degradation in α and ε values after annealing upto 350°C in air. AES studies on these multilayer coatings show that the sharp interface obtained in as-deposited film, is maintained even after annealing at 350°C. It is concluded that the degradation of these coatings is caused because of three processes: (i) the optical damage of the absorber layer, (ii) the decomposition of the individual layers, and (iii) the interdiffusion of the layers. In case of PbS/SnO_2 and PbS/CdS, the first process is taking place at temperatures $>$ 400°C and $>$ 350°C respectively. The second process has been observed in PbSe/CdSe at temperatures $>$250°C. The PbS/ZnO coating degrade by the third process at temperatures $>$ 400°C. The $(PbS)_{1-x}$-$(CdS)_x$ composite coatings are stable upto 300°C.

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