Failure Behavior of Electroplated Co₆₀Ru₄₀ layer on NiSi_x/Si Substrate for Copper Metallization

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To avoid copper diffusion into silicon substrates and prevent the formation of copper silicide, a thin layer (diffusion barrier) between the copper layer and silicon substrate is introduced. A thin cobalt-ruthenium barrier layer and copper were deposited on textured (001) silicon with nickel silicide by an electroplating method in this work. The sample presents Cu/Co₆₀Ru₄₀/NiSi_x/Si. The structures of Cu/Co₆₀Ru₄₀/NiSi_x/Si were characterized by scanning transmission electron microscopy (SEM), scanning electron microscopy (STEM), energy dispersive X-ray spectrometry (EDS), and powder X-ray diffraction (XRD). The results show that cobalt atoms diffuse more easily to nickel silicide than ruthenium atoms at high temperatures. The failure of Cu/Co₆₀Ru₄₀/NiSi_x/Si can be attributed to copper penetration through the Co₆₀Ru₄₀ and nickel silicide layers and the formation of copper silicide.

Keywords: Textured silicon; Electroplating; Solar cells; Diffusion barrier

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