Stress Evolution During Reactive Film Formation

Personnel

K. P. Liew, Y. Li, and C.V. Thompson

Sponsorship

Singapore-MIT Alliance (SMA)

Reactive film formation is widely used in the processing of micro- and nano-devices. Common examples include oxidation of silicon and formation of metal silicides through reactions between metallic films and silicon, the latter being an example of solid-state reactive film formation. During reactive film formation, the molar or atomic volume of the substrate material is significantly changed as it is incorporated into the reaction product. This volume change should lead to a large stress that would affect both the reaction rate and the stress state of the reaction product. The stress generated during reactive film formation may also affect what phase forms as a reaction product. We are studying stress evolution during reactive formation of nickel silicide films, using substrate curvature measurements. We find that the stress generated during reactions is partially relieved through mechanical relaxation, as the reaction proceeds. We are independently characterizing the rates of stress generation and stress relaxation, in order to better understand the stress conditions at the reacting interface. We are also developing experimental techniques that will involve the use of micromachined devices to apply stresses to reacting surfaces, and to make more sensitive measurements of evolving stresses.