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Modeling of initial growth by electric conductance variation of substrate

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A model of the conductance variation as a function of average thickness d of the deposited film has been proposed in initial growth on resistor or semiconductor substrate and correlated it with growth modes. Theoretical and experimental results are compared. The proposed model provides a potential for the *in-situ* characterization of initial film growth mode during the deposition. Modeling of the conductance variation at initial growth before the detection of the current resulting from tunneling effect leads to the following conclusions.

i) When the number of islands with constant size increases with the average thickness d or the growth mode is 2D, the conductance is proportional to d.
ii) When it is 3D growing, the conductance is proportional to the $d^{2/3}$.
iii) The conductance is a function of the sum of (i) and (ii).

For substrate, SiO_x film of 3000 Å thickness as a resistor substrate was deposited on Si substrate by using ion beam sputtering method. And, Sn film was deposited by neutral Sn metal evaporated thermally through the nozzle of PIBD, simultaneously measuring its electric conductance. The resistance of the SiO_x film substrate was about 10^6 Ω. In case of a insulator substrate of BK7 glass, there is a sudden onset of conductance at the thickness of 38 Å. The conductance of Sn on SiO_x substrate is higher than that on the glass substrate.

According to the present model, the 3D growth portion was estimated up to 95.3 % in depositing Sn on SiO_x substrate, which is also well consistent with experimental results. It should be possible to estimate the growth state at initial growth by *in-situ* measuring the conductance with the thickness and interpreting its curve in detail.