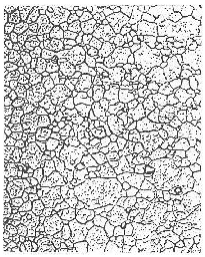
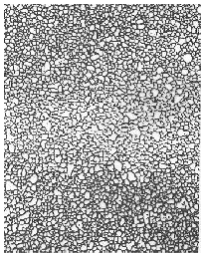
Al Grain Structure on Different Substrates

Illustration

- Around the late eighties, the necessity came up to use a **diffusion barrier** between the **Al** - metallization and the **Si** substrate becasue the rection of **Al** with the **Si** in contact holes with cross sections **< 1 µm^2** became a problem. One material of choice was **TiN**, another one **Ta**.
  - The grain structure of the **Al** layer (and with it other properties, e.g. the electromigration resistance, depends significantly on the substrate).
  - Below you can see the representative pictures (identical scale) that illustrate this point.



Aluminium layer on top of a **Ta** layer



Aluminium layer on top of a **TiN** layer

- Close examination revealed that the substrate influences:
  - Grain size
  - Grain size distribution
  - Texture
  - Degree of **Si** precipitation
  - Macroscopic stress
  - Microscopic stress
- All of these properteis may influence the performance ot the **Al** conductor - and this gives you an idea of what it means to introduce a new material into a fine-tuned product.