6.1.2 Infrared Microscopy

- Materials that are transparent to visible or - more important - **infra red light** (***IR***) may be investigated in transmission. This usually requires that the sample is optically polished on both sides. Especially semiconductors are transparent in **IR** light and **IR** microscopy is often used to investigate defects; particularly in **III-V** compounds. Defects may be rendered visible by:
  - **Polarization microscopy**. Elastic strain fields may rotate the polarization angle of polarized light to some (small) degree. The strain fields around defects can thus be made visible; an example is shown in the link.
  - **Absorption contrast**. Precipitates, for example, consist of some other material with different optical properties - it may not be transparent to **IR** light. In this case they would be directly visible as dark spots.
- If the primary defects are not precipitates but e.g. small dislocation loops resulting from vacancy agglomeration, they may be turned into a precipitate by a technique called **defect decoration**. This is usually done as follows:
  - Diffuse a fast moving element into the sample (e.g. **Li** or **Cu** for **Si**) at relatively high temperatures (however, without changing the primary defect configuration).
  - Cool down sufficiently fast to nucleate the precipitation of the decorating element *only at defects*, but not so fast that not enough diffusion jumps are possible and you do not get any precipitation. If you cool too slowly, homogeneous nucleation may produce precipitates everywhere and the technique is useless.
  - The primary defects are now heavily decorated with impurity precipitates and visible in **IR** microscopy (or other techniques). However, the dimensions have been enlarged, the primary defect structure may have changed, and you must keep in mind that you are now looking at a different defect from what you wanted to study in the first place!
- Nevertheless, **IR**-microscopy with or without decoration, has made important contributions to the study of defects in crystals. Its weaknesses and strengths can be summarized as follows.

Strength	Weaknesses
• Relatively cheap • Partially quantitative (strain fields) • Large and small areas can be investigated at medium resolution (ca. **1 µm**).	• Well polished surfaces on both sides required • Involved specimen preparation if decoration is used • Often not very specific as to the nature of defects • Only applicable to "medium" defect densities • Not overly sensitive • Interpretation uncertain if decoration techniques are used.