Cavity Surface Topography From Optical Inspection

Fermilab

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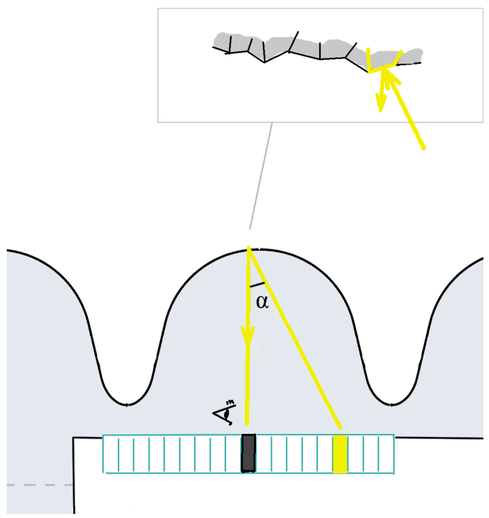
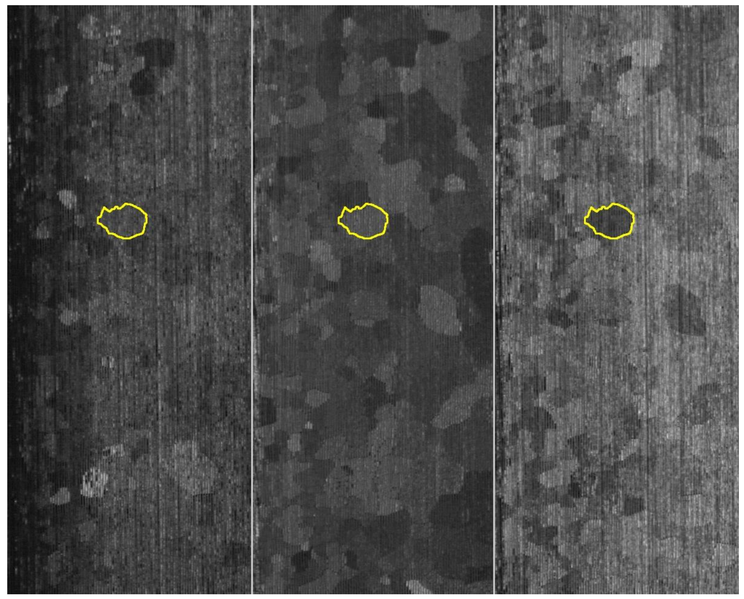
Abstract: Characteristics of the cavity surface geometry such as roughness affect cavity performance. The optical cavity inspection system at Fermilab allows us to obtain pictures of cavity surface at different lightning conditions. By analyzing the images of some fixed location inside a cavity taken while the light source moves progressively along the axis we can deduce some topographical information of that surface. In the large-grain cavities after BCP, grains are oriented at distinct angles to the surface and, therefore, reflect light in different directions. We developed a simple algorithm to calculate the angle distribution of the grains and thus to estimate the roughness. We discuss this method and the results of the analysis of the actual cavity surface.

Model and experimental setup

A simple model for cavity surface. We assume that the surface is made up from grains oriented at different angles to the surface plane. The grains are considered flat.

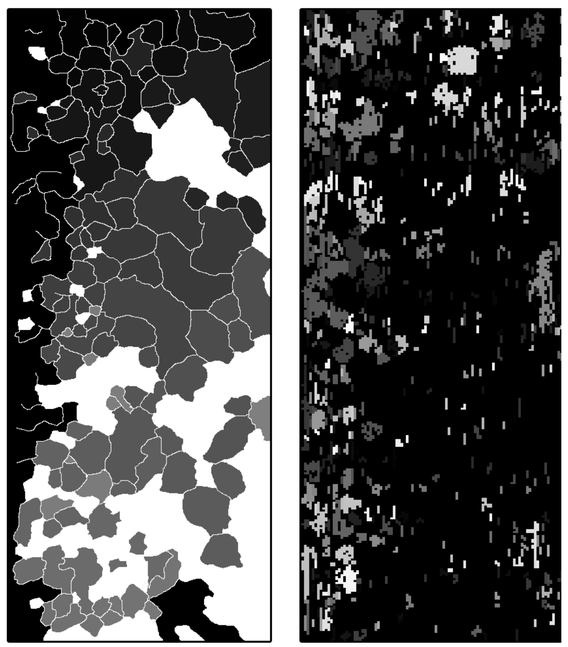


The system has 20 LED lights located at both sides of the camera aperture. We sequentially turned each of them on and off. The angle α ranged from -40 to 40 degrees

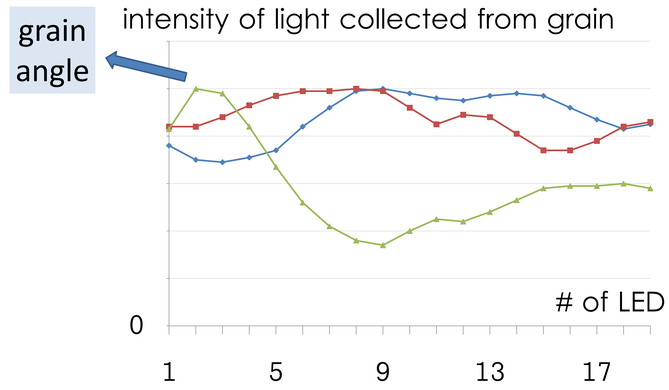


Example: snapshots for three different lights turned on.
Grains have a peak in reflection at some angle (one grain is highlighted.)
Vertical stripes are mechanical polishing artefacts.

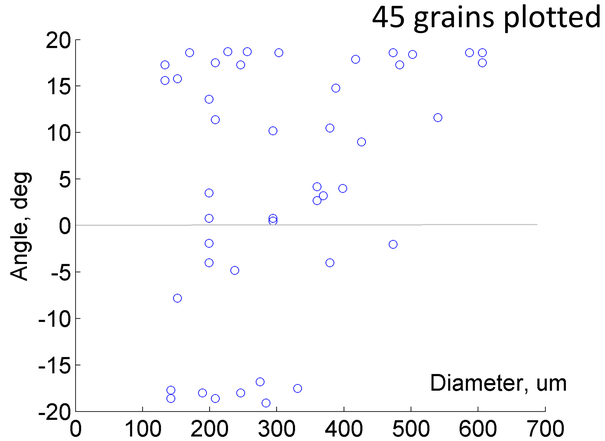
Grains were separated and labelled by colour
(a) manually; (b) by grain recognition algorithm



grain size



Curves for some grains have a pronounced peak. If there is a peak for some curve, we can calculate its position and, therefore, figure out the angle of the grain relative to the surface.



Grain size (diameter) and angle distribution

The method is a simple way to acquire information about grain angles distribution of HAZ in a cavity but is limited to estimating angles at 100-500 um scale for new and BCPed cavities (large grain, big angles)