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Influence of the scratching radius on the grinding process of glassy ceramics

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Abstract – This study addresses the effect of the radius along which abrasive particles scratch the surface during the polishing process. The occurrence of micro-scale scratches having a particular scratching radius were quantitatively estimated with the aid of computational simulations, which were based on the kinematic parameters adopted for the polishing process. The evolution of texture as well as the material removal rate was found to vary according to the position at the tile surface, and some empirical correlations between kinematic parameters and the resulting texture were suggested.

Texture of polished products defines not only the tribo-mechanical properties of the surface but also the glossiness expected for the product. Predominance of micro-scale scratches having different curvatures and even directions is usually noticed even in regions exhibiting considerable glossiness, as result of the kinematic adopted for the polishing process. For ceramic materials the material removal takes place mainly by generation and propagation of cracks around the trajectory of the abrasive contacts. Thus, according to the radius along which abrasive particles scratch the surface, different types of interactions between those cracks can occur. Therefore, different removal rates and surface quality may be expected. This work investigates the influence of the scratching radius on the removal rate and on the final texture of the polished surface of glassy ceramic materials. Tiles from two kind of glassy ceramic material containing a homogeneous and heterogeneous microstructure were investigated, being respectively a commercial float glass and a porcelain stoneware tile. A variable speed polishing machine, mark Bühler model PowerPro^{TM} 5000, was adapted so that different kinematic conditions, either hypocycloids or epicycloids, could be available for carrying out the polishing process. Both tiles were submitted to the polishing process separately during 30 minutes. A cylindrical pin with a diameter of 10 mm containing particles of silicon carbide was used as abrasive, with a normal force of 25 N. Abundant tap water was used as lubricant. After the polishing process the texture of the surface was characterized by profilometry, optical microscopy and also white light interferometry. Subsequently, a simulation algorithm was developed in order to furnish the scratching radius for each abrasive contact, based on kinematic equations available in literature [1]. The cumulative sequence of abrasive contacts undergone by each region over the tile could be then quantitatively attained and the corresponding distributions of scratching radius were recorded along the complete polishing process. According to the results, a good agreement between measurements and simulations was obtained. The evolution of texture was found to occur in different ways according to kinematic conditions performed by most scratches.

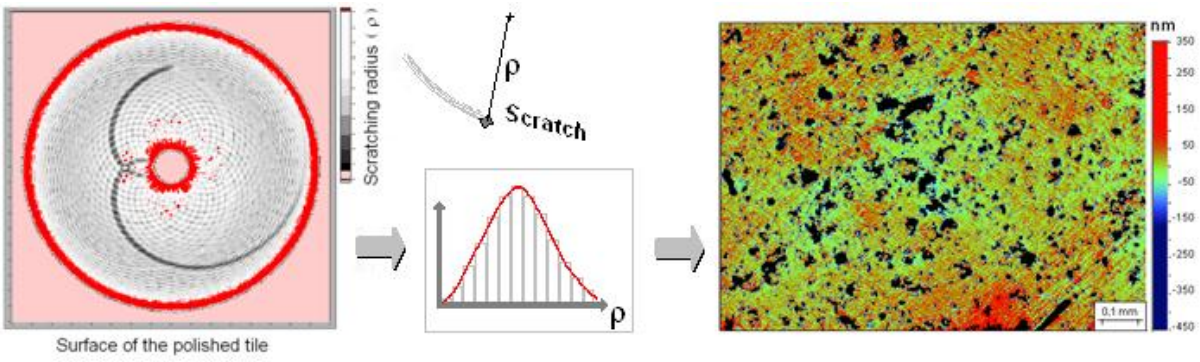

Figure 1: Simulation of the spatial distribution of scratching radius and the corresponding influence on the final texture

References

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