

# A sapphire nanostructure fabrication method based on friction-induced hydroxyl dehydration condensation

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*Single crystal sapphire is an important photoelectric material, which shows broad application prospects in various fields such as precision optics and epitaxial growth. Sapphire with nanostructures has received extensive attention due to its unique properties. However, due to the high hardness and brittleness of sapphire, it is difficult to obtain sapphire nano-structures by mechanical processing. In this study, a method for preparing sapphire nanostructures based on friction-induced hydroxyl dehydration condensation is proposed. The friction between SiO<sub>2</sub> and sapphire causes the dehydration and condensation of hydroxyl groups to form a Si-O-Al bonding bridge. The atoms on the sapphire surface move under the pull of the Si-O-Al bonding bridge during the friction process. Due to the miscut angle on the sapphire surface, the atoms have a tendency of step arrangement, which leads to a gradient of the surface energy barrier. The Si-O-Al bonding bridge breaks at the higher surface energy barrier, resulting in the accumulation of atoms on the surface of sapphire and the formation of nano-step structure. The result of EDS shows that the atoms on the surface of sapphire are transferred to SiO<sub>2</sub> in one direction, while the atoms of SiO<sub>2</sub> are not transferred to sapphire. Compared with other preparation methods of sapphire nanostructures, this method has the advantages of low cost, easy operation and environmental friendliness, which provides a new idea for the preparation of sapphire nanostructures.*

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