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Colloidal Silica Polishing Based on Micromechanical Removal Action and Its Applications

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A processing technique for producing a mirrorlike strain-free surface is described. This technique uses a polishing agent which has two special features. First, relatively soft, superfine particles are used to limit the atomic removal unit, and second, a colloidal suspension of particles is used in order to make the polishing rate highly efficient. By applying the polishing agent with a suitable polisher, a mirrorlike strain-free surface can be created. It is thought that this polishing method can be applied to almost any substrate, because the polishing principle is based on the micromechanical removal action of the superfine particles. This paper describes the mechanism of this processing with reference to examples using various single-crystal substrates, such as sapphire, GGG, $LiTaO_3$, Si and LaB_6, used in electronics or optical devices. The polished surfaces are confirmed to be strain-free with the surface roughness Rmax being around 10 Å.

1. Introduction

In order to fully display the performance of recently developed electronic and optical parts comprising a variety of hard and brittle materials, a physically perfect status must be achieved[1]. A versatile polishing technique for processing a strain-free mirrorlike surface is also prerequisite for the new crystal materials which are expected to become constituents in novel systems in the future.

The basic principle of processing the strain-free mirrorlike surfaces of crystal