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Synergetic Effects of Water and Sulfur Dioxide Treatments on Wear of Soda Lime Silicate Glass

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Abstract : This study is focused on the synergetic effects of water and sulfur dioxide treatments (SO_2 treatments) on the mechanochemical wear of SLS glass. It is found that the wear behavior of SLS glass in humid air is very sensitive to the water and SO_2 treatment environments based on the wear test using a ball-on-flat reciprocation tribometer. When SLS glass is treated with SO_2-without, the presence of water, the wear resistance of SLS glass in humid air becomes significantly higher compared to the pristine glass. However, when SLS glass is treated with SO_2 with the presence of water, the wear resistance of SLS glass decreases remarkably with increasing in the relative humidity (RH) from 0% to 90%. Further analyses indicate that when sodium ions are leached out of SLS glass surface via the water and SO_2 treatments, the mechanochemical properties of SLS glass surface become different depending on the RH. At lower humidity, the nano hardness of the Na^+-leached surface is higher, and it can contribute to the enhanced wear resistance of SLS glass. In contrast, at higher humidity conditions, the SLS glass surface is more hydrophilic, and substantial wear debris can be found inside the wear track of SLS glass. Those phenomena suggest that adhesive wear and abrasive wear dominate the wear mechanism of SLS glass in humid air, causing the decreased wear resistance of SLS glass with increasing the RH. These results may not only provide a deep understanding of the wear mechanism of SLS glass but also helpful for operation process of functional and engineering glasses.

Keywords : soda lime silicate glass, wear, water, SO_2
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