Tribological Performance of Laser Textured Translucent Duplex α/β-Sialon Composite Ceramics

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초 록: Optically translucent Sialon ceramics was fabricated by hot pressed sintering method. The Sialon ceramics was laser textured and their tribological performance was observed. Starved lubrication method was applied on Sialon ceramics with different dimple spacing under a load of 10N and at room temperature. The material having high dimple spacing (200 μm) shows low coefficient of friction. The material shows mild wear and therefore, wear rate of steel ball (meeting partner) was observed to measure wear rate. Different phases Sialon ceramics were analyzed by XRD patterns. Moreover, the mechanical properties of the Sialon ceramics were observed.

1. 서론

Laser Surface Texturing (LST) has created huge influence in texturing, because of the applicability of it on almost all materials such as metals, ceramics and glass, to produce topographical features. Frictional forces and wear rate can be minimized by the introduction of selective micro-structures on the sliding surfaces using LST. According to most of the studies, these microstructures can serve either as micro-traps for wear debris in either lubricated or dry sliding, or micro-reservoirs for lubricant in the cases of starved lubrication conditions, or micro-hydrodynamic bearing in the cases of full or mixed lubrication. Thus, textured surface helps to increase the thickness of the lubricating oil film between the mated surface such that the transition of the boundary lubrication regime on to mixed lubrication regime and then into hydrodynamic regime may take place. Hence, it reduces the frictional force developed during the relative motion of the surfaces. In addition, closed micro cavities, like small circular pits, can perform the function of a hydrostatic micro-bearing. Actually, when two mated surfaces come close to each other during sliding; the fluid in the cavities gets compressed and produces a bearing pressure. The kind of structures, the geometry and the density of the cavities on the flat surface play an important role on the tribogical properties. In most cases, an optimized structure can only be achieved if it is adapted to the tribological system.

2. 본론

The result obtained when steel ball of diameter 12.7 mm is slid against the surfaces with 10 N load and speed 5 cm/s for 1 hr using 5W30 commercial oil as starved lubricant. It shows that the coefficient of friction of textured surfaces was found lower than the polished surface. The coefficient of friction was lowered as decreasing the dimple density. The 7% dimple density (200 μm dimple spacing) shows lowest coefficient of friction. This result shows the significant potential of laser surface texturing to reduce friction and wear.

Table 1. Wear volume and wear rate of polished and textured Mg-Sialon Ceramics

Surfaces		Wear volume, V(mm^3)	Wear rate, W (mm^3/N.m)
Polished		12.98 x 10^{-05}	72.1 x 10^{-09}
Textured	(80 μm)	5.02 x 10^{-05}	27.9 x 10^{-09}
Textured	(100 μm)	4.10 x 10^{-05}	22.8 xx 10^{-09}
Textured	(150 μm)	1.62 x 10^{-05}	9.0 x 10^{-09}
Textured	(200 μm)	1.12 x 10^{-05}	6.2 x 10^{-09}

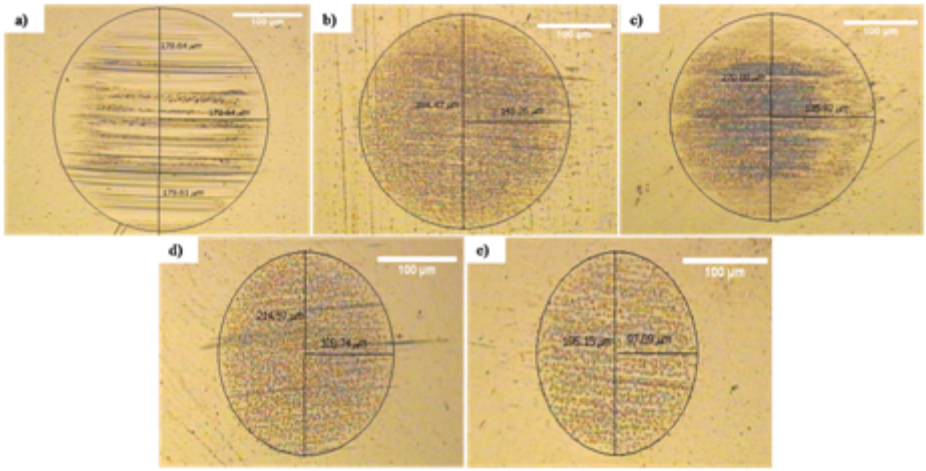

Fig.1. Optical micrographs of wear scar images on steel balls when slid against Mg-sialon ceramics : a) polished, b) , c), d), and e) textured samples with 80, 100, 150, and 200 um dimple spacing respectively.

3. 결론

Optically translucent Sialon ceramics was fabricated by hot pressed sintering method. The Sialon ceramics was laser textured and their tribological performance was observed. Starved lubrication method was applied on Sialon ceramics with different dimple spacing under a load of 10N and at room temperature. The material having high dimple spacing (200 μ m) shows low coefficient of friction. The material shows mild wear and therefore, wear rate of steel ball (meeting partner) was observed to measure wear rate. Different phases Sialon ceramics were analyzed by XRD patterns. Moreover, the mechanical properties of the Sialon ceramics were also observed.

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