World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:11, No:10, 2017

Acoustic Emission Monitoring of Surface Roughness in Ultra High Precision Grinding of Borosilicate-Crown Glass

Authors : Goodness Onwuka, Khaled Abou-El-Hossein

Abstract : The increase in the demand for precision optics, coupled with the absence of much research output in the ultra high precision grinding of precision optics as compared to the ultrahigh precision diamond turning of optical metals has fostered the need for more research in the ultra high precision grinding of an optical lens. Furthermore, the increase in the stringent demands for nanometric surface finishes through lapping, polishing and grinding processes necessary for the use of borosilicate-crown glass in the automotive and optics industries has created the demand to effectively monitor the surface roughness during the production process. Acoustic emission phenomenon has been proven as useful monitoring technique in several manufacturing processes ranging from monitoring of bearing production to tool wear estimation. This paper introduces a rare and unique approach with the application of acoustic emission technique to monitor the surface roughness of borosilicate-crown glass during an ultra high precision grinding process. This research was carried out on a 4-axes Nanoform 250 ultrahigh precision lathe machine using an ultra high precision grinding spindle to machine the flat surface of the borosilicate-crown glass with the tip of the grinding wheel. A careful selection of parameters and design of experiment was implemented using Box-Behnken method to vary the wheel speed, feed rate and depth of cut at three levels with a 3-center point design. Furthermore, the average surface roughness was measured using Taylor Hobson PGI Dimension XL optical profilometer, and an acoustic emission data acquisition device from National Instruments was utilized to acquire the signals while the data acquisition codes were designed with National Instrument LabVIEW software for acquisition at a sampling rate of 2 million samples per second. The results show that the raw and root mean square amplitude values of the acoustic signals increased with a corresponding increase in the measured average surface roughness values for the different parameter combinations. Therefore, this research concludes that acoustic emission monitoring technique is a potential technique for monitoring the surface roughness in the ultra high precision grinding of borosilicate-crown glass.

Keywords : acoustic emission, borosilicate-crown glass, surface roughness, ultra high precision grinding
Conference Title : ICPE 2017 : International Conference on Precision Engineering
Conference Location : New York, United States
Conference Dates : October 05-06, 2017