Three-Dimensional Modeling of Glass Lens Molding

The required accuracy for the final dimensions of the molded lenses in wafer-based precision glass molding as well as the need for elimination of costly experimental trial and error calls for numerical simulations. This study deals with 3D thermo-mechanical modeling of the wafer-based precision glass lens molding process. First, a comprehensive 3D thermo-mechanical model of glass is implemented into a FORTRAN user subroutine (UMAT) in the FE program ABAQUS, and the developed FE model is validated with both a well-known sandwich seal test and experimental results of precision molding of several glass rings. Afterward, 3D thermo-mechanical modeling of the wafer-based glass lens manufacturing is performed to suggest a proper molding program (i.e., the proper set of process parameters including preset force-time and temperature-time histories) for molding a wafer to a desired dimension and quality. Moreover, the effect of some important process parameters such as cooling rate and pressing temperature on the final size and residual stress inside the wafer is evaluated. Finally, it is noted that the suggested molding program minimizes the costly empirical efforts and raises the process efficiency.