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Machinability of hydrophobic acrylic polymer for customized intraocular lenses

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Intraocular lenses (IOLs) are diminutive plastic optical devices surgically implanted in the human eye to substitute the natural crystalline lens. The requirement for such cataract surgery arises when the natural lens becomes opacified by cataracts, significantly impeding vision or potentially resulting in blindness. In Germany, approximately 800,000 cataract surgeries are conducted annually.

To date, apart from molding, the prevailing method for manufacturing IOLs is single-piece on-axis diamond turning especially for small batch production and product variability as in toric lenses. In the scope of this project, an exploration of alternative techniques, i.e. off-axis diamond turning with fast-tool-servo (FTS), will be undertaken to increase the productivity and to manufacture highly customized lenses; a vacuum clamping system aiming to enable the simultaneous processing of multiple pieces will be developed. Specifically, hydrophobic acrylic polymer where deep cooling is required, rather than hydrophilic materials, will be used as raw materials, in order to meet the increasing market demand for hydrophobic IOLs.

The primary objective is to achieve enhanced production efficiency by realizing faster, more resource-efficient, and ultimately more cost-effective manufacturing processes. In this contribution, principal process designs for FTS machining including vacuum clamping of hydrophobic blanks are discussed and particular solutions are demonstrated; the collected manufacturing data of hydrophobic acrylic polymer using FTS off-axis diamond turning are analyzed.