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NUMERICAL AND EXPERIMENTAL STUDY ON COLD FORGING WITH CYCLIC SYMMETRICAL CROSS BALL GROOVES USING HARDNESS CONTROL OF HIGH SPEED TOOL MATERIAL

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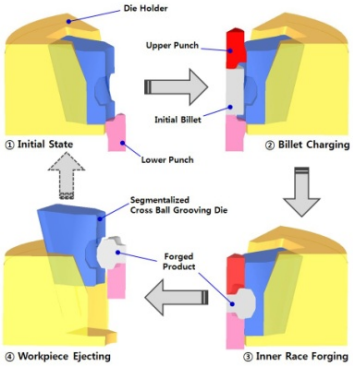
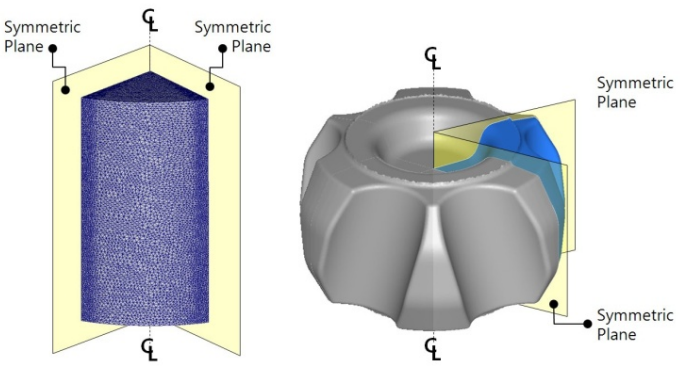
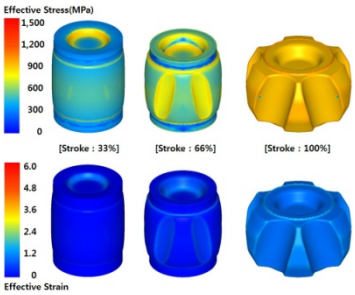
As one of automotive forged parts having cyclic symmetrical geometry, the inner race of constant velocity (CV) joints has six skew-angled cross ball grooves, and plays an important role in transmitting torque between the transmission and a driven wheel.[1,2] Until present, this metal forged component has been produced by a machining process including material removal due to the 3-dimensional complicated configuration. In this study, a cold forging sequence by using a semi-closed die set is proposed to obtain the inner race. And the operation mechanism of the proposed semi-closed die set is also considered to ensure the interference between each tool part.[3] The presented cold forging process consists of six longitudinally split cross ball grooving dies, a die holder, upper and lower forging punches. SKH51 tool material as a high speed tool steel is applied to fabricate the six split cross ball grooving dies, and its hardness (HRC) is also controlled to be about 61.0~63.0 for avoiding a series of die fracture due to high toughness of the tool material. Process design and detailed die design have been carried out, and those design results have been applied to the structural integrity evaluation of the proposed tool geometry. 3-dimensional numerical simulation and experimental investigations for this proposed cold forging process are also performed by using the initial billet material of the spheroidized and phosphophyllite ($Zn_2Fe(PO_4)_2$) coated SCr420H.



[Cold Forging Mechanism]

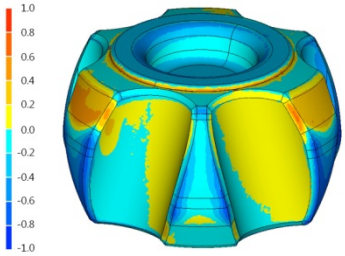


[Cyclic Symmetrical Geometry]



[Numerical Simulation Results]

[Prototype of Inner Race]



[Dimensional Accuracy (unit:mm)]

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