



Research Article

# SMALL BILLET FORMING OF POROUS SINTERED COPPER SHEET†

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## ABSTRACT:

*This study aims at forming small billets on metal sheet which is fabricated as a porous blank by using powder metallurgy technique. Pure copper disc was fabricated in 50% porosity and used as specimen for small billet forming. Thickness of the sintered specimen is 2~3mm and small billet was extruded into die cavity by punch indentation at extrusion ratio 4. Diameter of the die is 1.0mm. As the results, In the case of same punch force, a billet height of porous specimen became longer than conventional pure copper. When specimens were extruded at the same punch stroke, porous specimen showed little shorter billet height than the conventional one due to occurrence of shrinkage, but its punch force became 33% lower. Billet height became more longer in case of thicker sintered specimen. It is concluded that the porous specimens is useful to forming a small or micro billet with lower punch force.*

**Keywords:** Plastic Forming; Powder Metallurgy; Porous metal; Extrusion

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## 1. INTRODUCTION

Recently, the rapid growth of mobile electronic devices has expanded the demands for manufacturing of small metal parts. It is well known that typical metal forming process such as cold forging brings great advantage for mass production of metal parts in comparison with cutting process. However, with decreasing the size of metal parts, transferring of blank/billet becomes difficult due to increase of frictional effects in handling by robot hands. Hirota, et al., have suggested small billet forming of metal sheet to conduct forging process for miniature size metal parts [1]. In the process, extruded small billet remains on the sheet surface and it can easily locate to next die forging stage by handling and transferring of the sheet. Finally the small billet is forged to appropriate shape by proper die set, thus the miniaturization of metal forging process becomes achievable. However, since the contact area / volume ratio in the desired small billet shape increases with decreasing the processing size, friction loss between tool and billet becomes larger, and comparatively high forming pressure will be applied [2]. It means that the extruded billet height is clearly restricted by the yield strength of the punch and die, therefore aspect ratio of final forged parts restricted. Therefore special material properties will be demanded for the mass production of small metal parts by using existent metal forming techniques. Since the porous sintered metal has compressibility, it shows quite different yield property from conventional Von-Mises yield criterion. Especially in case of low density porous media, yield strength that is indicated in compression stress-strain curve shows very low with larger strain [3]. It is expected that the porous sintered materials avoid pressure increasing in the miniature forging process and achieve higher billet height in the small billet forming process. This paper proposes using porous sintered metal as a raw material for miniaturizing cold forging process. Small billet forming of porous sintered copper material has been carried out.

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