1. Introduction

Severe plastic deformation processes can be defined as those processes that induce very high plastic strain in a metal in order to cause grain refinement. Though such processes have been around for many decades, there has been a recent upsurge in a new class of SPD processes which generally have one characteristic feature, namely the size and shape of the work-piece remains unchanged after SPD processing. Older techniques, such as forging, extrusion or rolling, used either singly or in combination, result in a product shape substantially different from the starting billet. Extrusion, for example, can impart very large strains by reductions in area of 100:1 or greater. But the extrudate is generally longer and of smaller cross section than the starting billet. The new SPD processes, such as constrained groove pressing (CGP), equal channel angular extrusion or pressing (ECAE/P), high pressure torsion (HPT), accumulative roll bonding (ARB) and multi-axial compression/forging (MAC/F) all aim to keep the starting and finishing work piece shapes the same. CGP, on which the current project is based on, is discussed below, along with some of the other processes. Among the processes discussed, some like ECAE/P, MAC/F, and HPT introduce severe plastic deformation on bulk materials, while others like CGP, ARB, and RCS are con-shear work on sheet materials.

Commercial purity aluminum sheets are subjected to a severe plastic deformation technique called constrained groove pressing. In this study for the first time by using some technical optimizations, a strain magnitude of 6.9 is imposed to the sheets. The grain size evolution during severe plastic deformation is studied using Williamson-Hall analysis on X-ray diffraction pattern of the deformed samples. These results and transmission electron microscopy observations show that constrained groove pressing process can effectively refine the coarse-grained structure to an ultra fine grain range. The results of mechanical tests show that imposing strain in range of 0-5.75 causes to strengthening of sheets. However imposing more strain reduces the strength and hardness of the sheets. Considering the hardness results and effect of specimen thinning before tensile test on yield stress and UTS, it is concluded that two