The present thesis aims to produce feedstock materials of wrought Al-Mg-Si based alloys for the semi-solid process. Nowadays, the semi-solid process is becoming an attractive technology to produce light-weight products with superior mechanical properties. The use of Al-Mg-Si wrought alloys as the light-weight structural materials in automotive industries is becoming increasingly important. In Al-Mg-Si alloys, it is generally difficult to produce and control favorable semi-solid microstructures. Therefore, the development of a new forming technology and feedstock materials is highly required.

In this work, the deformation-semi-solid-forming (D-SSF) process for several Al-Mg-Si-Mn and Al-Mg-Si-Cr alloys has been successfully developed in order to produce refined spheroidized \( \alpha \)-Al phase in the semi-solid state. The spheroidization of the \( \alpha \)-Al phase is strongly accelerated by heavy deformation using 60% cold-rolling. It is found that the rapid heating rate of homogenization process coarser and rod-like particles of the Mn containing dispersoid, while the slow heating rate produces finer and homogeneously distributed particles. In the D-SSF process, coarse Mn containing dispersoid particles are effective to introduce strain by deformation and to refine recrystallization and spheroidized grains of \( \alpha \)-Al phase. The grain size of the high Mn (0.7Mn) containing alloy is much smaller than that of the low Mn (0.4Mn) containing alloy. The rapid heating to the semi-solid state is effective to refine the semi-solid microstructure. The grain size of the alloy heated at 644 degree is finer than that heated at 637 degree with shorter holding times. The complete die-filling for the disk shaped products is successfully achieved in the alloys semi-solid heated at 646 degree. The 0.2% proof stress and UTS (ultimate tensile strength) of the fabricated D-SSF products in this work are in the ranges of 300-350MPa and 330-390MPa, respectively. Especially, the high Mg containing alloy exhibits high strength and high ductility compared with other alloys.

Further development of alloys with controlled composition and optimized process conditions has been performed. In new Al-Mg-Si-Mn alloys, it is found
that the small grains of 80 - 90 mm are successfully obtained in the high Si and Mg alloys even by 30% cold-rolling. In these alloys, low semi-solid temperatures about 625 - 630 degree are effective to produce refined spheroidized $\alpha$-Al phase, being useful for fabrication.