Ductile cast iron that is developed in spheroidizing flake graphite by added Mg alloy is broadly used for autoparts and mechanical structure parts by it has sterling mechanical property. And, RE is added as spheroidizing agent. But, RE makes for formation of chunky graphite on heavy sectioned castings. Chunky graphite decrease mechanical property. Sb is added in order to avoid formation of chunky graphite. It has been reported that Sb brings forward to pearlite on matrix. But, it is not clear what the effect of Sb on shapes of graphite in ductile cast iron is.

After development of ductile cast iron, there are many reports about the formation and growth mechanism of spheroidal graphite. In addition, it is not clear what the effect of Sb on shapes of graphite in ductile cast iron is. Therefore, the aim of this study is the observation of spheroidal graphite in ductile cast iron to clarify the effect of Sb addition for formation of spheroidal graphite. For scanning electron microscopy of graphite structure, the metallic matrix was dissolved away by deep etching in a 10% nitric acid solution. The cross-sectional TEM specimens of the spheroidal graphite were prepared by Focused Ion Beam System (FIB). The microstructures of spheroidal graphite were observed by SEM with S-3500H (Hitachi, Co., Ltd.) and TEM with Topcon EM-002B. Fig. 1 shows the optical microscope image of base alloy and 0.097Sb. As a result of observation, chemical compound and porosity existed mostly in region of less than 5µm. Therefore, the image analysis performed in region of more than 5µm. As a result of image analysis, almost all the graphite particles present in the heats have circular in shape. Compared with the base alloy, graphite like a perfect circle increased in 0.097Sb. Fig. 2 shows the particle size distribution of base alloy and 0.097Sb obtained by image analysis. Spheroidal graphite in 0.097Sb increased below 15µm in particle size distribution compared with base alloy and the average size of spheroidal graphite decreases. In SEM observation, the surfaces on spheroidal graphite were asperity in base alloy, while it was smooth in 0.097Sb. In TEM observation, cross-section of the central part in spheroidal graphite was observed the shape of a fan that it was framed blocks, while the internal structure was observed smoother with the spheroidal graphite in 0.097Sb. The domain below 5µm in nearly center of the spheroidal graphite was analyzed in the incidence orientation [0001] of graphite structure. The incidence orientation was analyzed that is [0001] Tilted 90 degrees in circumference of the spheroidal graphite.
Fig. 1: The optical microscope images of base alloy and 0.097Sb alloy.

Fig. 2: Particle size distribution of basic alloy and 0.097Sb.