

cubic” (fcc). This means that the atoms of copper occupy the edges of a cube and in addition the centers of each area between the edges. That gives in result the highest density in a package, as 72% of the room is filled and the outer electrons can flow relatively easy from one atom in the lattice structure to another, leading to the excellent electrical conductivity of copper. Furthermore, this structure also allows that copper can be rolled to foils. So all metals which can be rolled to foils have this “copper structure” like silver and gold.

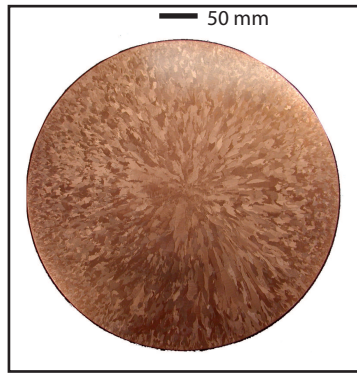


Figure 2.1.3: Grain Structure of a Cast Copper Billet (Source: Aurubis AG, www.Aurubis.com)

In theory, the crystal structure should be infinite and ideal by a repeating “fcc”-structure, but in reality it is neither ideal nor infinite, as there are always dislocations and distortions in the crystal structure. Furthermore, massive copper in practical applications never consist of only one crystal (“single crystal copper”) but of a lot of small crystals - the grain structure. According to the number and intensity of the imperfections in the crystal structure slight different mechanical properties like hardness or strength can result. The grain structure depends on the pretreatment of copper and on the conditions of solidification of copper from a melt. If a melt is cooled down rapidly, copper crystallizes in a fine grain structure, whereas if cooling is very slow, coarse crystals are formed. In Figure 2.1.3 it can be seen that a cast copper billet has at its outer border a finer grain structure than in the middle, because solidification starts rapidly at the outside and grows more slowly to the center of the billet. If a copper melt is solidified within less than a second, no crystallites are formed but an amorphous material like a glass is formed (“metallic glass”).