



Hitachi LC-OFC ® loudspeaker cable



Copper is manufactured in a range of purities. The base product is standard bar refined copper (TPC or tough pitch copper). This is used for most power and audio cables. The next grade is 'high purity' which can overlap the 'oxygen-free' grade, the latter being processed to minimise its oxygen content.

In Japan, Kamada, chief engineer of Hitachi Cable Ltd, speculated that cable sound differences are due to conductor's crystal structure, and that the metal purity determines the number of crystals in a given length of wire. In particular, residual oxygen in copper resides at the crystal boundaries as a semiconducting copper oxide barrier or junction.

Kamada chose to make a trial speaker cable using a good conductor which was liquid at room temperature and hence non crystalline. The obvious choice was mercury, and so trial 'cables' were constructed using polythene tubes, suitably terminated and filled with mercury. Critics heard a significant improvement in sound quality using this conductor.

Kamada, reasoned that the residual oxygen impurity in copper was responsible for limiting crystal growth in the processed metal, and that the larger the crystals produced, the fewer the number of boundaries or junctions in a given length of conductor. By using a further refining stage coupled with a zone annealing process commonly used in semiconductor material refining, the growth of very large crystals was encouraged. The high ductility of copper provides an additional enhancement: when drawn into wire, the crystals stretch into long fibres, multiplying the benefit in reduced crystal junctions many times.

The end product, Hitachi's Linear Crystal wire, consists of bundles of long, single crystal fibres running in the direction of the wire. Ideally the crystals would be long enough to run the entire wire length, but the reduction in the number of crystal boundaries is so great compared with normal cable that further increases in crystal length would probably not provide much in the way of an improvement.

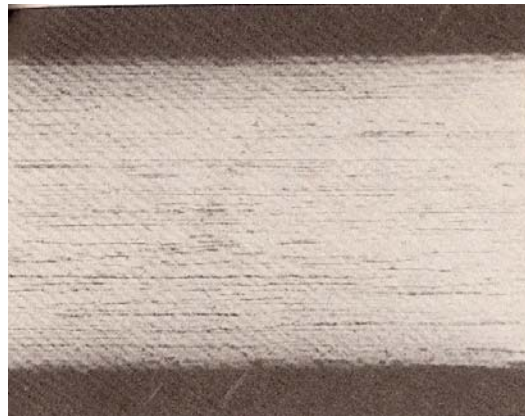


Material	Number of crystals / metre
Bar refined copper	150,000
Oxygen free copper	50,000
LC – OFC ®	200 - 400

Microscopy has shown that drawn LC crystals can commonly reach 5,000µm in length, while the average crystal size in ordinary cable is 10µm.



Crystal structure of conventional OF copper (x290).



Crystal structure of LC copper (x250).

This property of crystal elongation by wire drawing may be the underlying explanation for thin strands sounding better than thick ones, since the further drawing required for the former results in a reduced number of crystals per unit length.

