Professor Dr. Jan Czochralski - an inventor

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The origin of the Czochralski method of crystal growth has been associated from the very beginning with the name of Jan Czochralski (1885-1953). Unfortunately, recently his discovery has been questioned. In this communication I would like to point out some facts which allow to update our knowledge on the subject.

The Czochralski method (CZ) is widely used in growing single crystals for applications in the electronics technology. The idea of Czochralski method is based *on pulling a crystal from the melt* but it is certainly different from the other known methods like Bridgman and Verneuil methods [1]. The method was discovered in 1916 by accident and the paper reporting the results was published in 1918 [2]. This paper reports the description of a lifter and its junction with wire. At that time Czochralski investigated the growth of metals and their velocities of growth, and obtained single crystals of a few mm in diameter and length up to 150 mm. It should be remembered that Professor Jan Czochralski was a metallurgist and he investigated various processes of metal solidifications and crystallization. However, he was also interested in several other fields [3]. Anyone curious to know the number of papers Czochralski published in the field of growth and characterization of metals and their alloys may easily find them in Chemical Abstracts. He is also an author of several patents but it is not my aim here to compile a list of his achievements in the form of papers and other activities because they are easily accessible cite them all here [3,4].

The CZ method has been improved and cited from its very beginning. For example, in 1918 Wartenberg [5] used seeds (zinc wire) to grow the crystals of zinc. Later, in 1922 Gomperz [6] called for the first time this method by Czochralski's name. Later works dealing with the method are by Mark et al. in 1923 [7], Sachs in 1925 [8] and others. It is worth noting that up to the Second World War scientists were mainly interested in the properties of metals and their alloys. However, after the war scientists became interested in the growth of various materials applied in electronics technology, thanks mainly to the discovery of transistors. Initially, germanium and silicon were grown, but later semiconductors, oxides, fluorides and other binary and multicomponents compounds were also obtained as crystals. Gordon K. Teal, a scientist at Bell Laboratory in Murray Hill, USA, used the Czochralski method for the growth of germanium single crystals. He presented his results at the Oak Ridge Meeting of the American Physical Society in 1950 and the results on crystal growth were reported in Phys. Rev. [9,10]. One of the sentences there states: "*germanium single crystals of a variety of shapes, sizes and electrical properties have been produced by means of a pulling technique distinguished from that of Czochralski and others in improvements"* [10]. It should be noted that crystal growth technology of CZ method is continuously being improved and developed even today. It is just sufficient to turn over the pages of Journal of Crystal Growth to ascertain this fact.

Last year, H.J. Scheel [11] published in a review paper in the Journal Crystal Growth. It was an invited lecture given at the 11th American Conference on Crystal Growth and Epitaxy, ACCGE-11, held in August 1999 in Tucson. He questions the role of Jan Czochralski in the discovery of the method that is named after him and tries hard to dump (weaken) his contributions to materials science. In my humble opinion, from the perspective of today everything with which we deal in our day-to-day life (including the spiral growth theory of Burton, Cabrera and Frank; the contribution of Volmer to nucleation and of Stranski and Kossel to growth processes; or the Hartman-Perdok theory of growth morphology; and the life and deeds of Christ) can be questioned. The question naturally is: what for? However, the fact is that Professor Jan Czochralski was really a great stature in the 20th century, and it is no wonder that even the tunneling microscopy was his idea [12].

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