

DSCM 32P A METHOD FOR MEASURING MICROWIRE PARAMETERS

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The most common techniques for measuring microwire geometrical parameters are provided by post manufactory measurements. These techniques are incompatible within automated production of microwire. A specialized meter is usually used for core diameter measurement on casting, which allows the operator to monitor the diameter of microwire and control the casting process [2]. Its typical accuracy is of a 5 to 10% order, within quite narrow limits. Other methods of measuring thin wires are based on scattering and diffraction effects of a laser beam [1]. These methods are quite precise and accurate, but at the same time, exigent to environmental conditions and wire vibrations during measurement process.

The proposed method is a good challenge to provide quick measurements of microwire geometrical parameters and can be implemented into an automated process of microwire manufacturing. Light absorption effects represent the basis of the described method. The visible light absorbed by the microwire must be analyzed for measuring the microwire core diameter. The purpose of the method is to obtain a lower or even absent light absorption of the glass coat compared to the core.

Figure 1 shows the approximated transmission quotient of light for Pyrex like glass. A higher transmittance quotient results into a lower light absorption in glass. It is evident from the figure, that the absorption effects are quite weak for the visible light up to the mid-range of infrared spectrum (0.4-2.5 μm). In this context, one can suppose that light attenuation is smaller for the microwire coat. The absorption value of ultraviolet light in the microwire glass coat is higher than the absorption value of visible light at the same light intensity. The key of the described method is an average absorption value of the microwire for different wavelengths of the light beam.

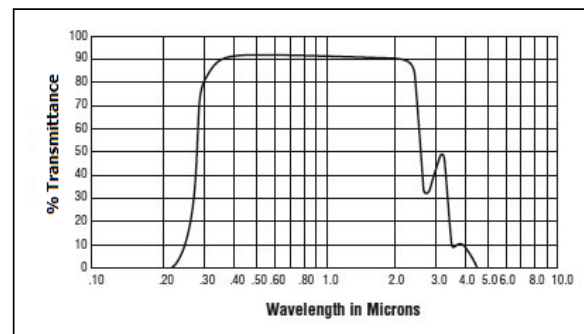


Fig. 1. Light absorption of Pyrex-like glass.

The measurement method is based on light attenuation of the microwire. LEDs or lasers can be used as light source with a certain wavelength range. The light sources must provide a range of light absorption values depending on the core diameter and the thickness of glass coat. Absorption values are obtained using scattering, diffraction and shadow effects of the light beam.

The shape of light beam represents a start point for measuring microwire parameters. The shape of the light beam must be rectangular or elliptical (oval) according to the measurement method. The described method proposes that the microwire has to intersect the light beams in a way that the light attenuation and scattering would reach maximum values. The axes of the light beam shape must be perpendicular to each other. A pair of collimation groups has to be identical, which means that the wavelength of light emitters, the emitted light intensity, the light shape, the collimation quality, the light focusing, and the spectral sensitivity of photodetectors must have identical parameters.

[1] Soraya A. Khodier, "Measurement of Wire Diameter by Optical Diffraction", SPRINGER, Journal of Optics, March 2003, Volume 32, p. 19-25.

[2] S. Zaporojan, C. Plotnic, I. Calmicov, V. Larin, "A Knowledge-Based Approach for Microwire Casting Plant Control". IRMA (Ed). Nanotechnology: Concepts, Methodologies, Tools, and Applications, Chapter 69, p. 1464-1482. Information Science Reference, Hershey New York (2014).