D42 The Distinction Between Arc Melting and Fire Melting Using X-Rays

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Learning Overview: After attending this presentation, attendees will better understand the feasibility of using X-rays as a tool for the distinction between arc melting and fire melting.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by introducing an effective tool for the distinction between arc melting and fire melting.

Molten marks found on copper wires at the scene of the fire can be largely divided into primary arc melting, secondary arc melting, and fire melting. For decades, many studies have been conducted to make a distinction between primary arc melting and secondary arc melting, but it is only possible to partially differentiate them under limited conditions.

The method of using Void in the inside of arc melting, among the methods proposed to differentiate between primary arc melting and secondary arc melting, mostly shows conflicting results. The results of preceding research and literature related to Void indicate that, although it is difficult to differentiate between primary arc melting and secondary arc melting, there are various types of Void in the inside of arc melting and that there are a much smaller number of Void in the inside of fire melting than that of arc melting.

Arc melting is characterized by the external visual indicators of the following: sharp demarcation between damaged and undamaged area, round shape of artifact, resolidification waves, etc. In contrast to melting caused by an arc, fire melting is characterized by the external visual indicators of the following: visible effects of gravity on the artifact, extended area of damage without a sharp demarcation from undamaged material, gradual necking of the conductor, etc.

The Void analysis method can be used to differentiate between arc melting and fire melting when external visual indicators are not sufficient or are disputed.

In this study, the distribution of Void in the inside of molten marks was examined using 2D and 3D X-rays as well as appearance tests to devise a method of differentiating between arc melting and fire melting, and, as a result, it was found in some cases that using X-rays to check the distribution of Void could lead to a clear distinction. Other than non-destructive inspection using X-rays, it is also possible to observe Void in the inside of molten marks with a microscope, but it takes time due to many stages (cutting, molding, grinding, polishing, and etching), and it allows an observation only on one cross section, which implies that using X-rays is much more precise and efficient in checking the presence of Void.

Arc Melting, Fire Melting, X-Rays