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ON THE RADIOGRAPHY WITH BACKSCATTERED BETA-RAYS

ABSTRACT - The use of backscattered beta-rays and electrons in nondestructive testing e.g. film thickness measurements, composition determination of binary alloys, etc. is well known. However, mostly gauging techniques have been employed. Recently, the present authors demonstrated that backscattered beta-rays can effectively be used for radiographic inspection of surface layers. A suitable beta ray sensitive radiographic emulsion is put on a surface of the object and against it an extended area beta-ray source is pressed. A significant fraction of primary beta rays passing through the radiographic film and penetrating into surface layers is in numerous elastic and inelastic collisions scattered backward toward emulsion. The backscattering coefficient and hence also the response of the emulsion depends on the atomic number Z and atomic mass M of the scatterer, but is independent of its density. Experimentally has been verified that the photographic density is proportional to be scattering factor $Z(Z+1)/M$. Since the backscattered beta-rays are degraded in energy the sensitivity of the emulsion is also greater for the backscattered than for the primary betas. The resolution of the method depends on the maximum range of the radiation in the material. The resolution has been experimentally assessed by measuring the edge-spread function of sharp contact edge between two scattering materials of different atomic number. This simple and inexpensive method has found application in mapping of heavier elements in mineral and metallurgical samples. It can be also used for detection of cracks, voids inclusions of light materials and hidden surface corrosion. A few examples of various applications are given.