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Applicability Assessment of Surface Analysis Techniques for Regulating NORM-Containing Consumer Products in South Korea

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NORM (naturally occurring radioactive materials) refers to materials containing natural radionuclides such as ^{238}U, ^{232}Th, and ^{226}Ra, which are widely present in the environment. Under normal conditions, radiation from these radionuclides has a negligible impact on human health. However, industrial activities can lead to the concentration or transformation of NORM, potentially increasing radiation exposure risks[1]. In South Korea, numerous consumer products are produced that advertise negative ions and far infrared effects for the purpose of health promotion, and NORMs such as monazite and zircon can be used in the manufacturing process of these products. To protect the public from unjustified radiation exposure, regulatory measures have been implemented for consumer products and raw materials. Nevertheless, significant administrative efforts have been required to trace defective consumer products and raw materials due to past cases where manufacturers provided misleading information or evaded legal responsibilities.

Currently, the identification of minerals containing natural radionuclides in consumer products and raw materials mainly relies on indirect methods, such as estimating radioactivity concentrations, determining uranium-to-thorium ratios, and measuring emissions of radon(^{222}Rn) and thoron(^{220}Rn). However, these methods do not allow for the precise identification of specific minerals. As a result, current analysis methods have limitations in providing definitive evidence in legal disputes. Therefore, there is an urgent need to develop and refine techniques for regulating NORM-containing consumer products. This study assesses the applicability of advanced surface analytical methods, including micro-XRF, field-emission scanning electron microscopy (FE-SEM) with energy-dispersive X-ray spectroscopy (EDS), and Raman microscopy, for identifying NORM-containing minerals in consumer products.

[1] International Commission on Radiological Protection, ICRP Publication 103 (2007).