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Utilizing Reactive Model Systems to Elucidate the Chemical Context of Undeclared Radioactive Contaminants: A Case Study of the Ruthenium-106 Contaminant Detected in Europe 2017

Compositional and structural analysis to reveal the chemical context of interdicted nuclear or radiological material is a fixture of nuclear forensics, as regulated material originating from the nuclear fuel cycle will possess characteristic signatures that reveal its processing history and origin. In the limiting case, atmospheric detection of ultra-trace levels of radioactive material may play surrogate to lawful interdiction. In this instance, the virtual absence of stable material precludes the use of traditional forms of physiochemical analysis. How then do we access information pertaining to the chemical context of the radioactive contaminant?

Such was the case in October 2017 across Europe, with the detection of ruthenium-106. Using this instance as an example, we describe, for the first time, the use of selected reaction systems to reveal key information about the chemical composition of the ruthenium-106 contaminant. With systematic variation of reaction conditions, and examination of the subsequent fate of the ruthenium-106 contaminant, both general and highly specific deductions can be made to this effect. This information constitutes valuable empirical evidence to support a greater international investigative effort on the nature and origin of this material.

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