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Feasibility of Using Non-thermal Microwave Plasma for Nuclear Waste Management: A Detailed Study Backed by Plasma Spectroscopy

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Abstract: Plasma is probably the most underused tool applied for nuclear waste management. To study the feasibility of putting this technology in practice, a non-thermal microwave based atmospheric pressure plasma jet (MPPJ) had been developed. The device was characterized by spectroscopic technique prior to its actual deployment inside glove box to narrow down its operational regime and also tested on Ta, a known surrogate of Pu which showed its efficacy in etching. The device was then used for removal of Pu based synthetic radioactive wastes inside radioactive glove box. Thereafter, optimization studies were conducted to maximize decontamination efficiency and it was seen that oxygen in plasma plays a significant role. The same device was later scaled up to a multi-electrode model and used for similar radioactive waste removal. Both these devices under optimized condition could remove ~ 92% radioactive wastes and the scaled up model reduced duration by 50%.