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MASTER

Grounding Of Beta Sources By An Auxiliary Alpha Source*

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For beta spectral studies in magnetic lens spectrometers, where distortion from scattering must be kept to a minimum, sources are mounted on film backings made as thin as is compatible with strength requirements. Since the strongest backing materials are insulators, some mechanism is needed to prevent source charging.

A hot filament from a beam power tube has been used to prevent charging of electron emitters.[(1)] If the filament electrons were accelerated sufficiently through a grid, the resulting secondary emission from the source and backing might suffice to keep a positron source from charging. However, this method is inherently unstable in that positron source charging would retard the primary electrons and reduce the secondary emission. If the filament emission falls below the critical point where the secondary emission is momentarily inadequate, the sources potential will build up, reducing the yield of secondary electrons still more. When scintillation counters are used for counting the beta particles, the filament current may have to be

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turned off while counting to prevent counts due to the light from the hot filament. If the source charges to the grid potential while the electron gun is off, then no secondary emission can occur. Potential shifts of more than 6000 volts have been detected in ungrounded beta sources over a period of 24 hours. Although electron guns have proved successful for grounding of electron emitters, they are liable to failure as filaments may burn out or lose much of their emissivity.

A Po^{210} source furnishes a simple and reliable means of grounding both electron and positron sources. Po^{210} may be obtained from spent radium needles by reduction from a chloride solution on Ag plating. It decays to the ground state of Pb^{206} with emission of 5.3 Mev alpha radiation. About 10^{-3} percent of the transitions go to an excited state and produce an 800 kev gamma ray.[(2)] *

Po^{210} sources were obtained and covered with several liberal coats of Krylon or collodian to prevent loss of material. An $\sim$20 μc Po^{210} source was placed in the spectrometer 1.2 inches behind a 4 μc Na^{22} source (positron emitter) which was on a 20 $\mu g/cm^2$ Formvar backing. The charging rate, as observed by the charging counting rate at the most sensitive point on the beta spectrum, was found to decrease by $\sim$80%. When the source was placed 1/2 inch away no charging was detectable over a period of more than one week. The discharge is attributed mainly to the loss of electrons from the source and backing due to ionization by the alpha particles since few alpha particles will be stopped near the source. Since the ionization

*Most of the 5-day beta activity from Bi^{210} may be etched off with acid, then a holding period of 10 to 15 days will result in a fairly clean alpha source.

electrons have an average energy of the order of 20 ev, one would expect negligible charging from too much ionization. No extra counts due to the alpha source could be detected in the spectrometer with a 25 $\mu g/cm^2$ Formvar film in the beta source position and the alpha source moved up to a position 1/4 inch behind it.

Alpha rays striking a thin foil will produce many low energy electrons for discharging of electron emitters. An ~20 μc alpha source was covered with quarter mil Al foil and placed 2 inches behind an ~12 μc In^{114} source. No shift of the K conversion line was observed over a 12-hour period within detection limits of 60 ev. No extra counts were detected in the spectrometer with the 25 $\mu g/cm^2$ Formvar film in the beta source position and the Al covered alpha source 1/4 inch behind it.

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References

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[2] Strominger, Hollander, and Seaborg, Revs. Modern Phys. 30, 585 (1958).