Impact of the radiation quality on the performance of semiconductor dosimeters used for mammography quality control measurements

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Specific issues related to dosimetry in mammography

• Mean energy low
• Variety of radiation qualities
• Mo-Mo for calibration
  • IAEA TRS 457
  • IEC 61267
• Compression Paddle
• Mean glandular dose
  • $MGD = K_{air} \cdot g \cdot s \cdot c$
  \[\text{HVL dependent}\]
Dosimeters used

- Ionization chambers
- Semiconductor dosimeters
  - Dose, dose rate, HVL and tube voltage
  - Energy dependence of their response
    - Apply internal correction (black box)
  - Pre-selection of the radiation quality
Calibration set-up

- 8 semiconductor dosimeters
- IAEA dosimetry laboratory
- Traceable to primary standards
- Radiation qualities used:
  - W-Al, W-Rh, W-Ag
  - Mo-Mo, Mo-Rh
  - 25 – 35 kV
  - 50 mGy/min in 1 m distance
Results: air kerma rate

\[ N = \frac{\text{air kerma}_{\text{ref}}}{\text{air kerma}_{\text{meas}}} \]
Results: half value layer

$N_{HVL} = \frac{HVL_{\text{ref}}}{HVL_{\text{meas}}}$
Results: tube voltage

\[ N_{KV} = \frac{kV_{ref}}{kV_{meas}} \]
Conclusion

• Test of 8 semiconductor dosimeters in the IAEA calibration laboratory
• Large differences between the dosimeters
• Internal correction not predictable
• 2 dosimeter comply with manufacturer limits for HVL
• No dosimeter comply with manufacturer limits for tube voltage
• Further studies
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This work will be submitted to Medical Physics

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