Evaluation of the protective effect of nano-composites reinforced with Cerium-Oxide nanoparticles against diagnostic X-ray

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INTRODUCTION

Lead is a unique element in terms of attenuation for radiology X-ray. Unfortunately, it is so heavy that could not be for the long term as an individual wearable protective garment and is extremely toxic. Therefore, to find an appropriate alternative for lead has been studied by many researchers using other elements and compounds (1). The present research investigates, for the first time, the protective effects of cerium oxide nanoparticles (nanoceria) embedded in polydimethylsiloxane (PDMS).

METHOD

- Nanoceria based-polydimethylsiloxane (PDMS) was prepared by adopting its making procedure.
- The nanocomposites were characterized by Field Emission Scanning Electron Microscope (FE-SEM) and Thermogravimetric Analysis (TGA).
- Specimens were exposed by a diagnostic X-ray apparatus. In order to measure X-Ray attenuation, beam intensity was measured by the nanocomposites (I) and without it (I0) by a dosimeter "Piranha red" at narrow beam geometry (fig 1).
- The amount of attenuation was obtained using the following equation.

$$\text{Attenuation} = (1 - {}^{I}/_{I_0})\ \%$$

- Afterwards, the results were compared wit pure lead characteristics.
- The measurement procedures were well described through the reliable standard (2).

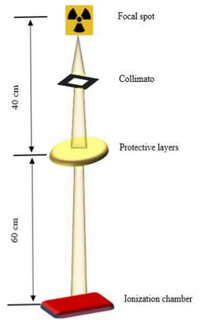

Fig 1. narrow beam geometry

RESULTS

As figure 2, the FE-SEM images of the fabricated nanocomposites show excellent dispersion of the nanoparticle. Surprisingly good, there was no agglomeration of nanoparticles even as increase concentration it. noteworthy point is that an increase in the weight percentage of cerium oxide from 25 to 35 percent delayed the degradation at about 20 ˚C (Fig 3). by increasing the percentage of nanoceria (10%) into the PDMS faced with a dramatic increase (15-20 %) in attenuation The maximum attenuation (76.66 %) at 60 kVp was achieved for concentration 35% of nanoceria (fig 4). Incident photons with Energy are attracted to the K-edges absorption of target atoms. Overall, nanocomposite weight of the lead equivalent was more than pure lead.

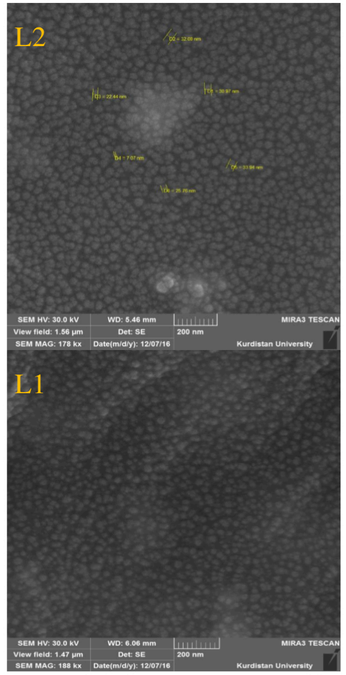

Fig 2. FE-SEM images of nanocomposites: L1 (25 wt%) and L2 (35 wt%)

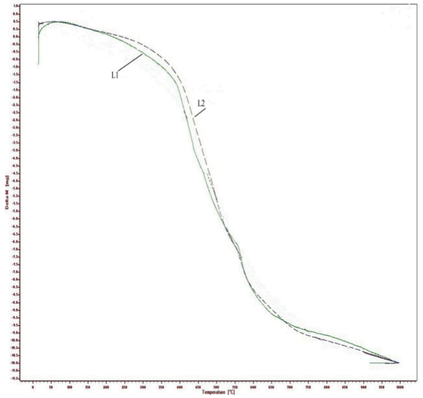

Fig 3. The amount of attenuation in terms of the mass thickness of different samples in the four studied energies.

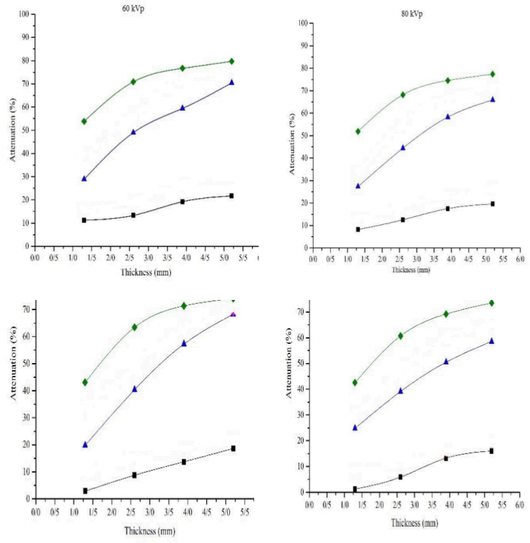

Fig 4. comparisons of attenuation capability among different thickness of sample L1, L2 and L3 (PDMS)

CONCLUSIONS

The investigation of attenuation has shown that cerium oxide nanocomposite, considering the weight factor, cannot alone have attenuated as lead equivalent. However, PDMS-based Nanocomposite had flexibility, high Shear modulus, non-toxic and economical.

REFERENCES

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ACKNOWLEDGEMENTS

The authors acknowledge helpful collaboration Nanotechnology Research Institute, Urmia University and Imam Khomeini University Hospital of Urmia

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