

## DEPOSITION OF RADON PROGENY DRIVEN BY ELECTROSPINNING

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### Abstract

Electrospinning is a process to create nanofibres by application of high voltage on the polymer solution. It is proved that nanofibres keep some amount of charge during their deposition and some of them are charged even few hours after that. The forming of the jet could be running in gas environment contains Radon. Radon decay creates progenies which are positively charged due to their  $\beta$  decay and these positively charged Radon daughters are then attracted and trapped by negatively charged nanofibers. This process can be used in several applications to protect humans against charged radio isotopes like for example in the case of terrorist attack or as active filters of radon daughters.

**Keywords:** Radon daughter's deposition, electrospinning, nanofibers

### Introduction

The surface of solution can be positively or negatively charged depending on the polarity of the source. Polymeric jets are then created by the destabilization of the surface of the polymeric solution by the actuation of electric forces (Lukas [4]). There is a massive evaporation of the solvent during the jet's flying, but some residual charge has been kept on the fiber. This residual charge has been patent mainly for ferroelectric polymers such as for example Polyvinylidene Fluoride (PVDF) which is permanently bipolar. They can attract negatively charged radon daughters.

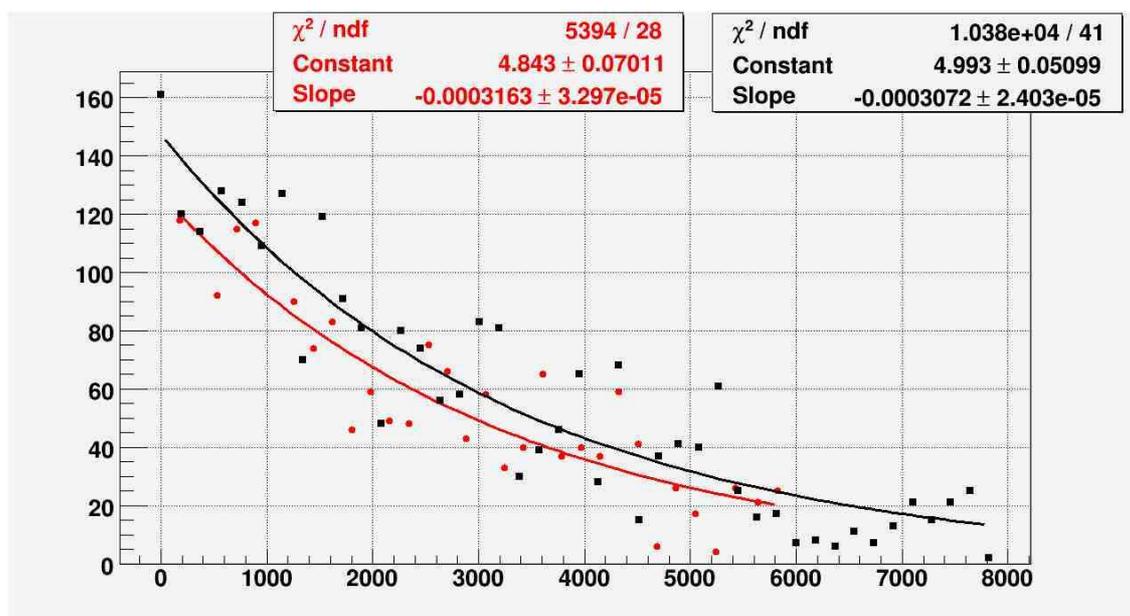
The description of radiant effects starts here with irradiation caused by Radon. Radon is the chemical element with atomic number 86. It is the invisible, radioactive noble atomic gas that in the nature results from radioactive decay of some forms of Uranium,  $U$ , that may be found in igneous rock formations beneath buildings or in certain building materials. Radon is being continuously produced by radioactive decay of Radium isotope  $^{226}Ra$ , as the consequence of Uranium decay, spread all over the world. Radon is one of the heaviest gases. The most stable Radon isotope,  $^{222}Rn$ , has a half-life of 3.8 days, viz Heinrich (1942) [1]. Radon gas and its solid decay products are recognized and considered to be a serious health hazards since they are carcinogens. However, the pathways linking Radon decay consequences to living tissues are not direct. The crucial links occur via a deposition mechanism of the radioactive Radon daughters, as introduced by Batkin [3]. Detail analysis of toxilogical aspects of Radon was described by Roper [2]. The deposition of Radon decay products on electrospun materials and electrodes of electrospinnings was studied using various detecting technologies ranging from etched-track detectors, proportional counters, gamma spectrometers, etc. Radon decay progeny are not gases ( $Po$ ,  $Bb$ ,  $Bi$ ) but solids. They can be attached easily to tiny aerosol particles, and these particles may be trapped in the lungs what results in a lung dose from alpha and beta radiation.

Radon,  $^{222}Rn$ , decay products are also intensively deposited onto surfaces of electrospun materials and electrospinner parts. The deposition is caused by an attraction between any negatively charged solids and positively charged radon daughters. Radon daughters have the electrostatic affinity to negatively charged surfaces since they are positively created as a result of the stripping of electrons from the parent atom during their radioactive decays. The

investigation of the deposition of aforementioned heavy metals should be critical for an application of nanofibrous materials in tissue engineering due to health hazards of heavy metals. Recent human health hazards increase because in modern industrial environment a human body often carries a negative static charge since a body potential up to tens of kilovolts can result from everyday activities such as walking across synthetic floors, working with plastic materials or from coming into contact with charged objects.

### Experiment

A series of electrospaying as well as electrospinning experiments have been carried out under special conditions to confirm that even scant mass of electrospun nanofibrous layer, not greater than tens of grams, can exhibit radioactive activity that should be more than four times higher than the natural background ( $123 \pm 8$  nSv/h, where SI unit Sv is the Sievert, derived unit of dose equivalent), in which samples were prepared, registered by twin Geiger-Müller Tubes of the Radiometer 'VOLTCRAFT HS - 036'. Measurements of this deposition were made with negatively and positively charged collectors, for various temperatures, to exclude effects from an electron shell (see fig. 1). All deposited nanofibers were stored on the bending spunbond textile and taken down from the collector before all dose measurements. For all samples we measured the same half-time with various radiation intensities. About one half lower irradiation intensities were detected on positively charged collectors, compared with positively charged ones under the same conditions.



**Figure 1.** Deposits of electrospaying and electrospinning materials of a mass around tens of grams exhibit high-energy excitations four times higher than the laboratory background ( $123 \pm 8$  nSv/h). The activity was registered by twin Geiger-Müller Tubes of the Radiometer 'VOLTCRAFT HS - 036'. Two independent samples were measured, one heated up to  $100$  °C (red) and second under room temperature to exclude effects from the electron shell.

Complex measurement of this process was done too. Results proved that radiation observed during electrospinning was a deposition of Radon progeny, what is in accordance with the observed asymmetry of observed radiation intensities from positively and negatively charged collectors covered by heaps of collected materials. Positively charged Radon daughters are more attracted by negatively charged bodies. Also was observed that Radon daughter deposits

are more attracted by a stable negatively charged collector than by a negative jet discharge that results in nanofibers. The fundamental general theory which explains process of Radon deposition in details was introduced by Batkin *et. al.* [3].

It is obvious that at the end of Radon radioactive decay is Lead isotope  $^{210}\text{Pb}$  with half time 22.3 years. This was analyzed by scanning electron microscope JEOL JED-2300 with EDS (energy disperse X-ray analyzer) and the amount of this isotope was found unmeasurable.

Another idea was to use ferroelectric polymers as active filters for positively charged isotopes. Ferroelectric materials demonstrate spontaneous polarization such as for example Rochelle salt. An example of polymeric material indicates ferroelectric feature is PVDF. Nanofibers made of PVDF were electrospun, parallelized and there collected.

### Conclusions

This process can be used in several applications to protect humans against charged radio isotopes like for example in the case of terrorist attack or as active filters of radon daughters. It was proved, that nanofibers can attract radon daughters and by this was it can be used as active filters for several applications. Anyway many another experiments has to be done in specially prepared radon room where is possible to set exact dose of radon disintegration.

### References:

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