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Studies of LENRA-toughened PVC non-woven membranes prepared by electrospinning technique

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OUTLINES

- INTRODUCTION
- EXPERIMENTAL
- CHARACTERIZATION
- RESULTS AND DISCUSSION
- CONCLUSIONS
- ACKNOWLEDGEMENTS

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INTRODUCTION

What's nanofiber ?

Defination:

Nanofibers are generally defined in the U.S. textile industry and Japanese and Korean strategic research initiatives as fibers of less than 1 μm in size. This is in contrast to the National Science Foundation current definition of nanotechnology, where structures are less than 0.1 μm in some critical dimension (ref. Application of Nanofiber Technology to Nonwoven Thermal Insulation Phillip W. Gibson, Calvin Lee, Frank Ko, Darrell Reneker, Journal of Engineered Fibers and Fabrics Volume 2, Issue 2 – 2007
also by other researchers such as
Benjamin Chu, Benjamin S. Hsiao
Departments of Chemistry[1], Materials Science & Engineering[2], Biomedical Engineering[3]
Colleges of Arts & Sciences, Engineering, Medicine
Stony Brook University

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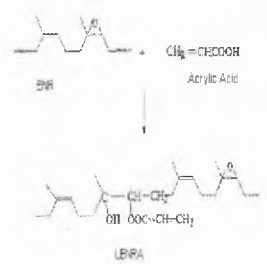
History of solid natural rubber research in Nuclear Malaysia



Before 1994: NR for coating materials
1994-1998: Preparation of liquid natural rubber (LNR) & LENR
2000: The use of LNR as compatibiliser in TPNR blends
2002: Synthesis of EB-curable NR-based oligomer (LENRA)
2004: LENRA as compatibiliser in TPNR blends
2006: The use of SANS to study the roles of LENRA as compatibiliser
2008: Reinforced LENRA as master batch
≥2010: LENRA as toughener in nanofiber via electrospinning technique

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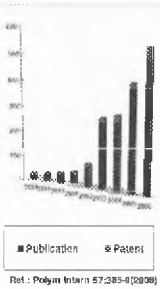
Status & Important features of electrospinning process

Suitable solvent – dissolving the polymer.
- **Suitable vapor pressure of the solvent**
- **Viscosity and surface tension of the solvent**

- **Adequate power supply – to overcome the viscosity and surface tension of the polymer solution to form & the jet to sustain**



Ref.: Polym Intern 57:385-8(2008)

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Most used polymers in electrospinning

- **Solution**
  - Cellulose acetate (CA)
  - Polyurethane (PU)
  - Polyacrylonitrile (PAN)
  - Polyvinyl alcohol (PVA)
  - Poly Lactic acid (PLA)
  - Nylon 6 (PA6)
- **Melt**
  - Polypropylene (PP)
  - Polyethylene (PE)
  - Polyurethane (PU)
  - Nylon 12 (PA 12)

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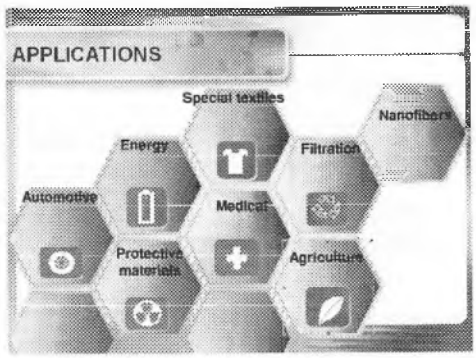

Slide from: NanoFMG, Turkey

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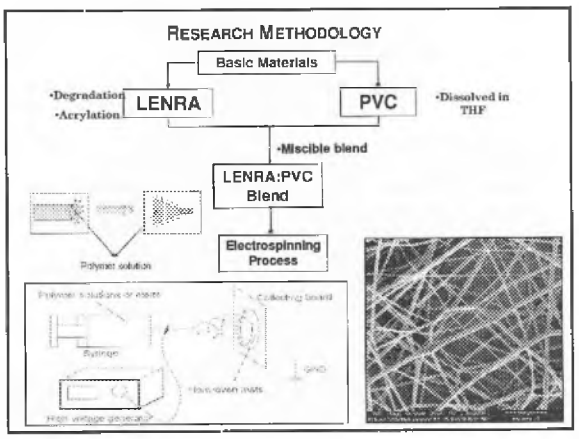
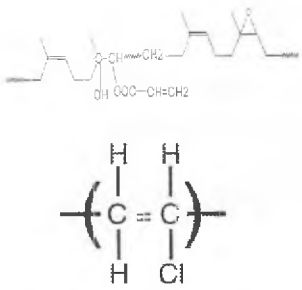


Miscibility of LENRA-PVC blend



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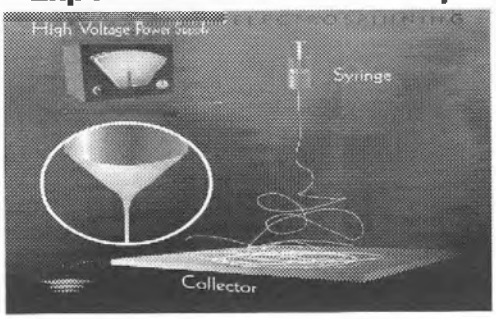
Experimental – the technique



http://nano.mtu.edu

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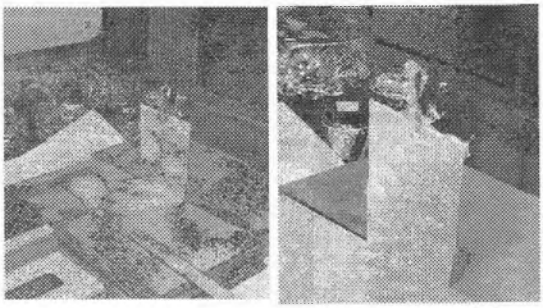
Collecting the fiber



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CHARACTERIZATIONS

- MORPHOLOGICAL STUDY
  - SEM
- MECHANICAL TEST
  - Mercury porosimetry
  - Tensile Test

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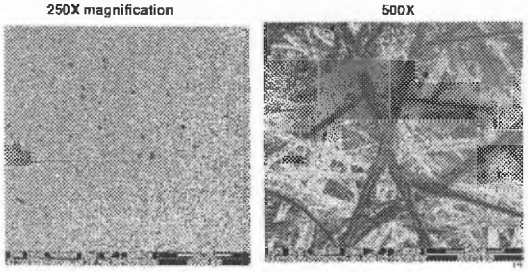
RESULTS AND DISCUSSION

- MORPHOLOGICAL STUDY
  - SEM PVC:LENRA 90:10 (0 kGy)

250X magnification 500X



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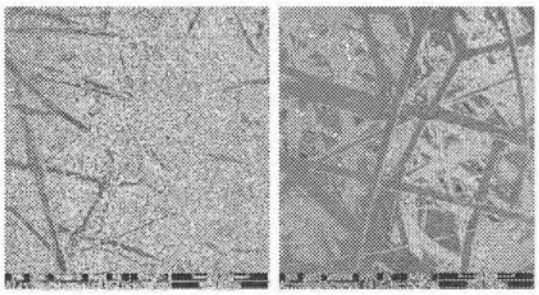
Irradiated 100 kGy

250X magnification 500X



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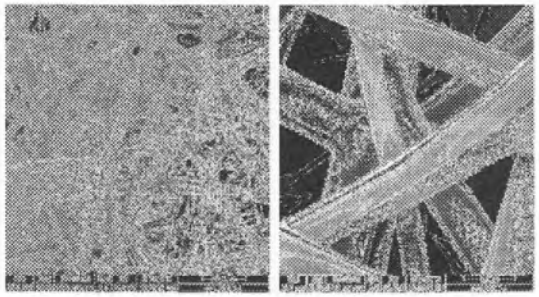
LENRA/PVC 50:50 (0 kGy)

1000X magnification 5000X



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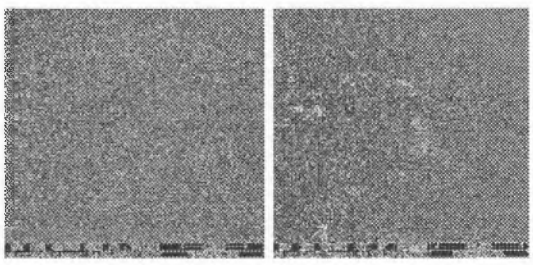
PVC:LENRA 70:30 (0 kGy)

30X magnification 100X



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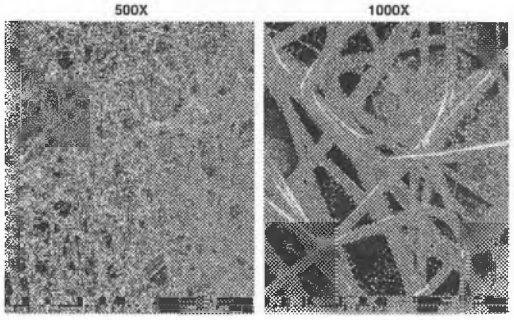
500X 1000X



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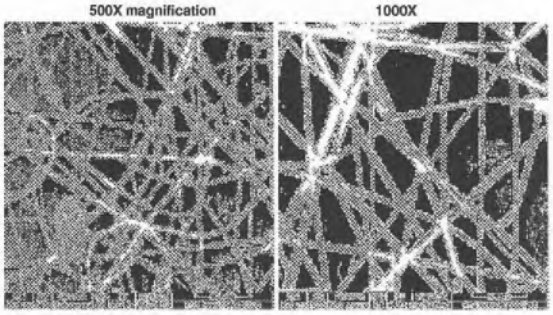
PVC:LENRA 70:30 irradiated 100kGy

500X magnification 1000X



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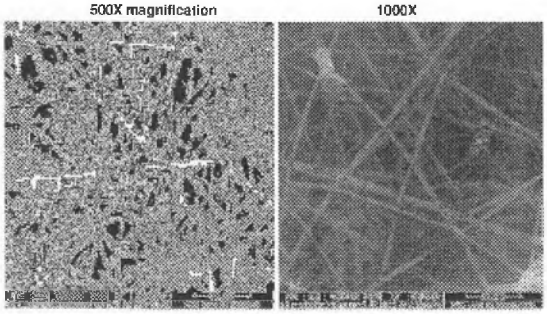
PVC:LENRA 70:30 irradiated 200 kGy

500X magnification 1000X



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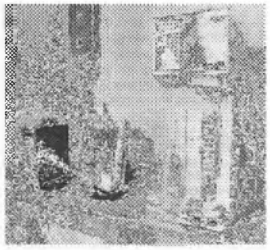
Porosity by mercury porosimetry



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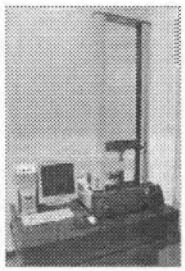
Tensile properties

Sample: Neat PVC

PVC:LENRA 70:30



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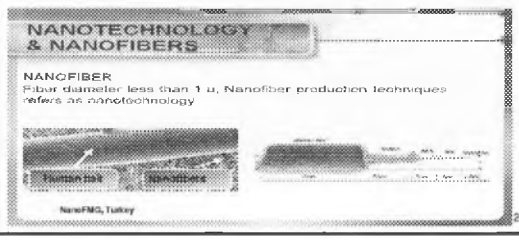
Conclusions

1. Simple electrospinning technique has been shown able to produce ultrafine non-woven LENRA-toughened PVC mat
2. Some toughening effects shown by radiation sensitive LENRA
3. The technique can be used for any other polymers as well to produce nanofibers



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- 4. Abd. Basit Shafiei, Alurtron
- 5. Rosley Che Ismail & other BTS staff
- 6. Dr Ishak Ahmad, Chemistry Program, UKM

and lot more whose names not mentioned here

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