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Electrospinning of bioactive glasses and amorphous calcium phosphates for biomedical applications

Context

Why using implants ?

- **Orthopedic prosthesis** : for articular pain and uncomfortable movements
- **Dental implant** : Replace a missing tooth

Titanium-based implants

- ✓ Low density, high strength, excellent corrosion resistance, non-toxicity
- ✗ Very limited bioactivity

Addition of bioactive coatings (CaP, Bioactive glasses)

→ Ensure implant fixation to bone/dental tissues

Well-used coating technic : **Plasma-spray**; but:

- ✗ Excessive thickness
- ✗ Possible delamination (and thus local inflammations)
- ✗ Overly stable phases

⇒ Study of an alternative depositing technique : **ELECTROSPINNING** capable of creating nanofiber mats and thus porosity favorable for cell activity

Method and tools

Fibres preparation

1. **Sol-Gel** synthesis + Mixing with a polymer to bring spinnability
2. **Electrospinning** of the sol-gel solution onto TA6V substrates
3. **Thermal treatment** of the fibres to control phase formation and get rid of the carrying polymer

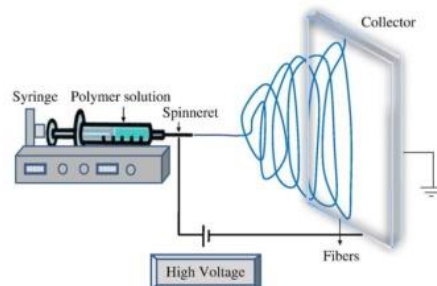


Figure 1. Electrospinning setup

Characterization tools

- Thermal behavior | TGA/DSC
- Coating morphology and homogeneity | SEM/EDS
- Chemical characterization | XRD, FTIR, Raman, NMR, ICP
- Biological assessment | Cytotoxicity, cell proliferation, ...

Results

Obtention of nanofibres after electrospinning and preservation of the fibrous structure even after polymer calcination

Inorganic materials obtained:

- Calcium phosphates
- Bioactive glass 45S5

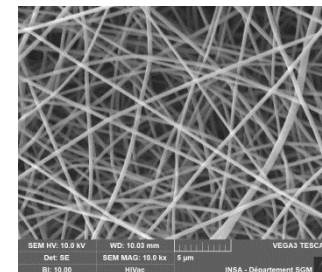


Figure 2. Example of 45S5 bioactive glass fibers obtained

Improved glass chemical homogeneity and fibres uniformity by changing sol-gel precursors

Reduced shrinkage and improved adhesion by adding an intermediate spin-coated layer between the substrate and the fibers