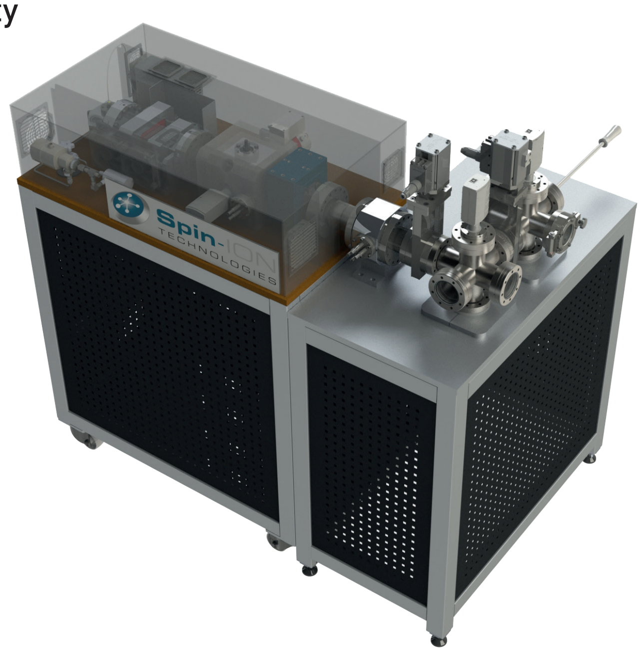
Spin-ION TECHNOLOGIES

The next memory revolution

Helium-S

The future of materials engineering

Precise control of inter-atomic displacements through an ultra-compact and ultra-fast He^+ ion beam facility

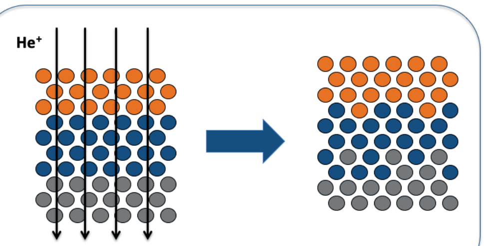


KEY FEATURES

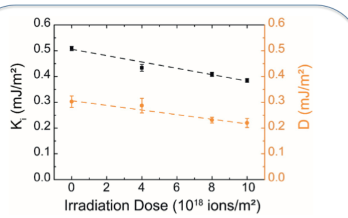
- **He^+ ions beam** with energies ranging from 1 to 30 KeV
- Electron Cyclotron Resonance **(ECR)** Ion Source
- **Ultra-fast homogeneous** irradiation on 20 mm wafer
- **Ultra-compact/small foot-print** facility
- **Standalone system or integrated** with existing UHV process equipment
- Hardware and software for remote control

KEY BENEFITS

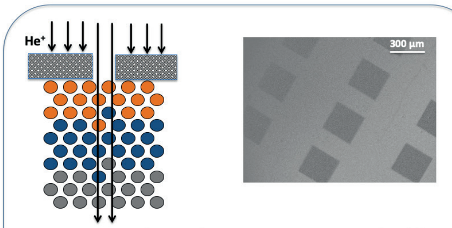
The key benefit of the technology is the **post-growth control at the atomic level** of structural properties in thin films. As state of the art, this technology can be used to precisely control magnetic properties of ultra-thin spintronic materials[1-10] including magnetic anisotropy, magnetization, Dzyaloshinskii-Moriya Interaction, damping,...



Engineering inter-atomic displacements through light He^+ ion irradiation



He^+ irradiation induced tailoring of interface anisotropy and DMI in W-CoFeB-MgO structures[7]



Kerr microscopy image showing a planar magnetic microstructure with modulation of perpendicular anisotropy using He^+ irradiation through a mask in CoFeB-MgO materials

[1] Physical review letters 91, 077203 (2003)
[4] Applied Physics Letters 98, 172506 (2011)
[7] Applied Physics Letter 115, 122404 (2019)
[2] J. Phys. D: Applied Physics 3, (2004)
[5] Journal of Applied Physics 113, 203912 (2013)
[8] Physical Review B 99, 054431 (2019)
[3] Applied Physics Letters 86, 022503 (2005)
[6] J. Phys. D: Appl. Phys. 51, 215004 (2018)
[9] Applied Physics Letter 116, 072403 (2020)
[10] Applied Physics Letter 116, 242401 (2020)

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SPECIFICATIONS

Type of ions	He^+
Energy range	1-30 keV
Energy resolution	< 50 eV
Intensity	From 5 to 50 µA, step <1 µA
Homogeneity	Intensity dispersion <+/- 1%, Angular dispersion <+/- 3°
Vacuum	10^{-6} to 10^{-8} mbar
Beam scan	Ultra-Fast xy scanner, range: 20 mm x 20 mm
Flux	10^{15} ions/cm^2/min at 10 µA
Beam purity	>1/10000
Facility dimension	1400 mm x 800 mm
Software	Full control of the beam parameters, Programmable Logic Controller (PLC)

ADDITIONNAL OPTIONS

Irradiation chamber	Irradiation chamber for 20 mm coupon, variable implantation angle, heating up to 500°C, measurement of the beam current, software control of the fluence, vacuum 10^{-6} to 10^{-8} mbar
Load lock	Transfer chamber for 20 mm coupon integrated with the irradiation chamber
Beam characterization	Faraday cup with passive cooling
Coupon size	Up to 200 mm

USERS

The technology has been used by University of California San Diego **(USA)**, University of California Davis **(USA)**, New York University **(USA)**, Georgetown University **(USA)**, Northwestern University **(USA)**, University of Lorraine **(France)**, SPINTEC Grenoble **(France)**, University of Cambridge **(UK)**, University of Manchester **(UK)**, Beihang University **(China)**, Nanyang Technological University and A*STAR **(Singapor)**, University of Gothenburg **(Sweden)**, Western Digital **(USA)**, IBM **(USA)**, Singulus Technologies **(Germany)**.

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