

Roger Kalvig @ Aix-Marseille Université, CINaM CNRS, Marseille

Mn_5Ge_3 and Mn_5Si_3 are two compounds exhibiting interesting magnetic properties in the field of spintronics. Both systems crystallize in the hexagonal D_{88} structure (space-group $P6_3/mcm$) and they can be grown epitaxially on Ge(111) substrates. However, they exhibit very different magnetic behavior. Mn_5Ge_3 is a metallic ferromagnet that presents a high spin polarization of the conduction electrons at the Fermi level, a Curie temperature of 296 K, which can be increased by carbon insertion, and a strong uniaxial magnetocrystalline anisotropy along the hexagonal c axis. On the other hand, Mn_5Si_3 is an antiferromagnetic alloy exhibiting a (meta)magnetic phase transition: antiferromagnetic with a chiral spin structure below 65 K and collinear above. A transition from ferro- to antiferromagnetic behavior has been reported to be around $x = 0.86$. The interesting issue is to get an insight into the transition between the ferromagnetic behaviors of the $Mn_5(Si_0Ge_1)_3$ films and the anti-ferromagnetic $Mn_5(Si_1Ge_0)_3$ films. This topic is currently investigated by the NMR group at IF PAN in cooperation with the group of prof. Lisa Michez at the Aix-Marseille Université. Professor Michez is a leading expert in epitaxial growth of silicon and germanium based heterostructures, in particular thin films of Mn_5Ge_3 , Mn_5Si_3 and substituted $Mn_5(GeSi)_3$ systems and the group leader in Centre Interdisciplinaire de Nanoscience de Marseille (CINaM). Our cooperation involves epitaxial growth on Ge(111) substrates of $Mn_5(Si_xGe_{1-x})_3$ films at CINaM and their study with NMR technique at IFPAN.

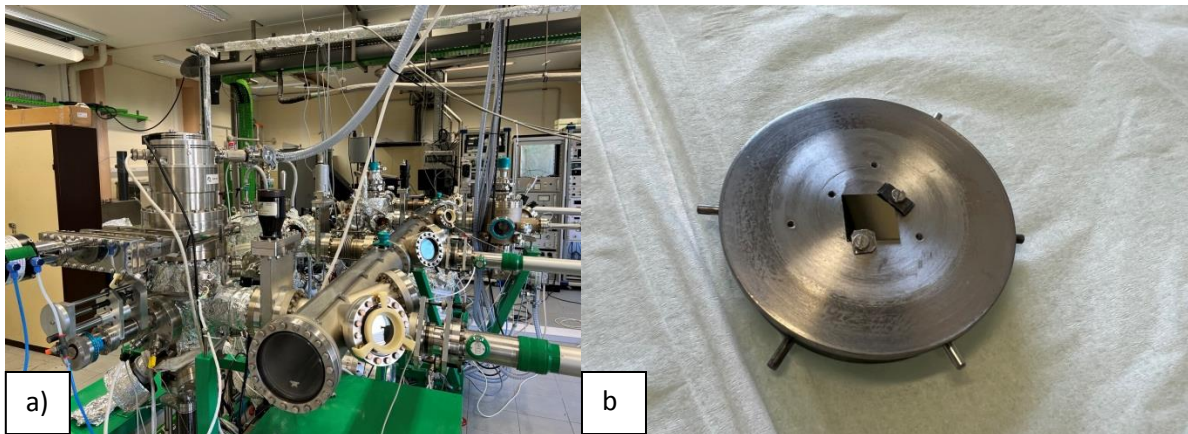


Figure 1. a) Four-chamber MBE device placed in CINaM laboratory at Aix-Marseille Université, b) chemically cleaned epi-ready Ge(111) wafer screwed on molybdenum holder(molyblock) before deposition thin film of $Mn_5(GeSi)_3$.

From 10.10.2022 until 21.10.2022 I was visiting the CINaM Laboratory in Marseille. As a part of our current ongoing project I had the opportunity to have a hands-on experience of the MBE apparatus and participate in epitaxial growth of two thin films of $Mn_5(Ge_{0.95}Si_{0.05})_3$ and $Mn_5(Ge_{0.45}Si_{0.55})_3$ which will be further investigated by means of Nuclear Magnetic Resonance at IF PAN in Warsaw. During the training, I enjoyed scientific discussions and brainstorming with all the members of the scientific group led by prof. Lisa Michez. The layout for a joint upcoming paper, as well as new prospective collaboration projects have been discussed. The new project will involve the modification of magnetic properties of MnGeSi systems by applying organic capping layer on the surface of the films.