# Controlling ferroic domain architecture in oxide heterostructures

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The integration of functional properties into oxide multilayer architectures demands for atomic precision. Conventional in-situ diagnostic tools guarantee high structural quality but are usually insensitive to the functionality targeted with the actual deposition.

By taking advantage of the non-invasive nature of optical probes, I will show that optical in-situ second harmonic generation (ISHG) analysis can be performed simultaneous to the pulsed-laser-deposition growth. For a ferroelectric compound, this translates in following the evolution of the spontaneous polarization in real time and with monolayer resolution throughout the deposition process [1].

Controlling both the surface termination and the interlayer coupling results in the growth of oxide heterostructures with an arbitrary sequence of up- and down-polarized ferroelectric layers. Moreover, when the electrostatic environment is changed, the domain state of the film continuously evolves enabling a full control of the polar state directly during the growth.

These examples illustrate the large capabilities offered by the implementation of ISHG as a growth diagnostic tool. The in-situ access to emerging properties enables an unprecedented degree of control that can promote the engineering of oxides functionalities to a completely new level.

[1] G. De Luca et al., Nat. Commun. 8, 1419 (2017)