



Contribution ID: 77

Type: oral

A new way to develop "LOW COST" instrumentation: the PICO RX diffractometer/XRf spectrometer enhanced with polycapillary lenses

Thursday, 8 June 2023 16:50 (20 minutes)

Here we present a new line of transportable and portable X-ray instruments. They have been manufactured based on a number of specifications:

- high sensitivity, low cost, cheap and easily programmable electronics, AI-based software and "open source" platforms

High sensitivity is achieved by adopting INFN polycapillary lenses, in particular a semi-lens for diffraction and a cylindrical lens for fluorescence. The low cost goal was achieved by adopting a construction based on 3D printing in carbon fiber and PLA. The electronics are based on programmable PSOC platforms, which manage the instruments together with ARDUINO MEGA boards. PSOC boards completely replace a complete "mother boards" full of components of the past. The software is built in "open source" and some of the most delicate routines have been created thanks to the use of the artificial intelligence of Chat Gpt4.0. Finally, commands and management are entrusted to a new class of "intelligent" LCD touch screens and Apps that can be easily managed with any type of device (PC, Tablet, Smartphone). Both instruments have a maximum power of the X-ray tube of only 4 W. For outdoor transport, given the Italian national legislation, the fluorescence system has a W tube with self-limited power supply at 30 kV. The same instrument, once reinserted in the chassis, becomes a bench system with a maximum acceleration voltage of 40 kV and an 8-position sample holder. The use of lenses increases the sensitivity of the aforementioned instruments by two orders of magnitude.

Using the technologies described, the prices of these instruments are placed in a market range accessible to small and medium-sized laboratories, including gemmological and cultural heritage restoration laboratories.

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Session Classification: S5: Applications & X-Rays