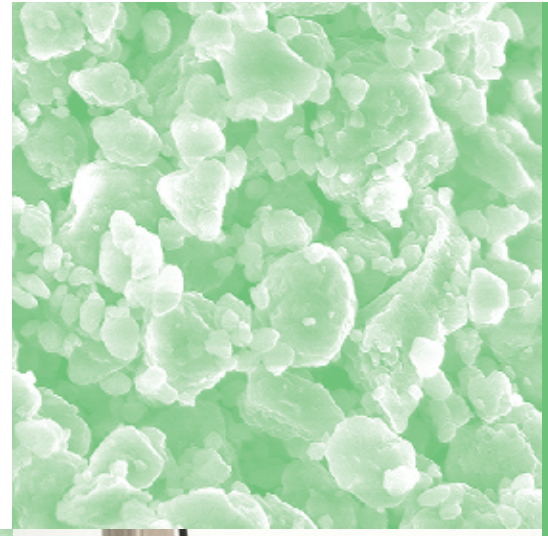


evicomagnetics

High pressure milling vial Gas-Temperature-Monitoring System

A unique and powerful method for the mechano-chemical one-step synthesis of nanoscale functional materials is provided

It involves high-energy ball milling in an especially designed vial, allowing in-situ monitoring of temperature and of pressure (maximum operating pressure 150 bar (15.000 kPa)) by incorporating a pressure-temperature measurement system as well as a radio emitter into the vial lid. An external receiver transmits the data to a data acquisition computer.

- Powerful method for the synthesis of nanoscale functional materials
- Insight in physical and chemical processes during milling
- Controlled one-step mechano-chemical synthesis
- In-situ monitoring of hydride, nitride or carbide formation
- Quick check of catalyst efficiency in hydrogen storage materials
- Time-consuming interruptive experiments can be avoided

Features

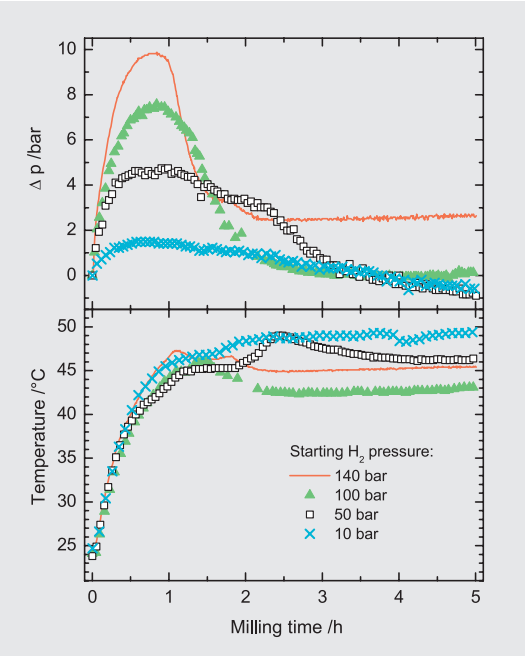
- Continuous **in-situ** monitoring of pressure and temperature during ball milling
- p_{max} = 150 bar of hydrogen (smaller pressure ranges with higher resolution available: up to 1-2-5-10-20-50-100 bar)
- Operation time up to 40 h
- Resolution of data acquisition 40 points/s
- Radio range up to 40 m
- Powerful dedicated software
- USB interface
- Volume of milling vial: 220 ml
- Vial material: hardened steel
- Swagelok ball valve

Options

Two channel system for simultaneous use of two milling vials

Example

One-step mechano-chemical synthesis of $NaAlH_4$, a prototypical high-density complex hydride, using reactive ball milling.
Evolution of (top) the hydrogen pressure variation Δp and (bottom) the temperature during milling of NaH + Al + 4 mol% $TiCl_3$ using different starting hydrogen pressures. Using low hydrogen pressure, the progress of the reactions is sluggish.



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Magnetic Domains – fast and easy ...

Advanced wide-field Kerr microscopes for magnetic domain research

Enhanced by image processing and equipped with electromagnets, the Kerr microscopes can be used to study domains and magnetization processes in ferro- and ferrimagnetic materials at magnifications that range between overview observations in the centimeter range down to the resolution limit of optical microscopy. Magnetization loops can be optically measured at selectable image areas (MOKE magnetometry), observing and recording the corresponding domain images at the same time.

Features:

- High-end wide-field polarization microscopes (Zeiss optics)
- High-resolution and sensitive digital CCD camera (Hamamatsu)
- Highly-stable LED light source
- x-y-Phi sample stage
- Adjustable aperture for variable contrast conditions (longitudinal, transverse and polar Kerr sensitivity)
- Rotatable compensator to correct for elliptical polarization and to perform depth-selective microscopy in multilayers
- Objective lenses, magnification 5x to 100x
- Field of view from several millimeters down to micrometers

Magnetic field options

- Rotatable electromagnet for in-plane magnetic field up to 300 mT (standard, sample size ‹ 35 mm) and 1.3 T (high-field pole shoes, sample size ‹ 4 mm)
- Quadrupole magnet for in-plane x-y magnetic field up to 200 mT, computer control of field direction
- Electromagnet for perpendicular field up to 0.9 T
- Air coil for perpendicular field up to 100 mT
- Single sheet magnet for electrical steel in Epstein geometry, combined with inductive M(H) loop recording
- Magnet holder, independently pivoted from x-y-Phi sample stage
- Bipolar power supply

LabView®-based software

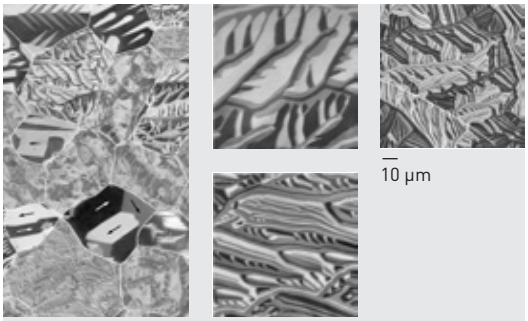
- Real-time difference image technique to subtract non-magnetic background for domain contrast enhancement
- Recording of single images and movies of magnetization processes
- Magnetic field control: DC, AC, rotating, AC-field demagnetization
- Recording of surface hysteresis loops ("MOKE magnetometry") with simultaneous domain movement observation. Faraday correction and loop shift correction. Anhysteretic MOKE loops can be measured optionally
- Ergonomic control by shuttle wheel
- User extensible

Options

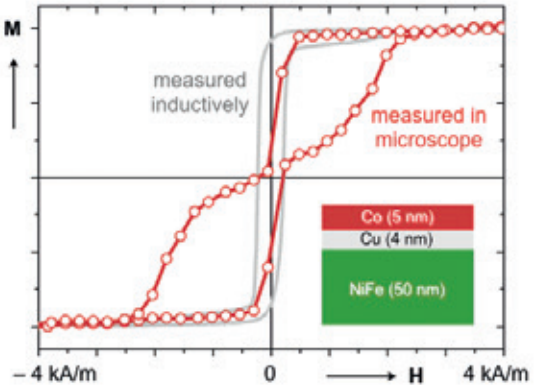
- Low (5 K ‹ T ‹ 300 K) and high (up to 850 K) temperature domain observation in optical cryostat and heating stage with in-situ application of magnetic fields
- Stroboscopic imaging, based on gatable image intensifier module (time resolution 5 nsec, max. repetition rate 200 kHz) or triggered LED light source (up to 25 kHz)
- High-resolution microscope can optionally be combined with low-resolution optics for overview imaging in centimeter regime

Examples

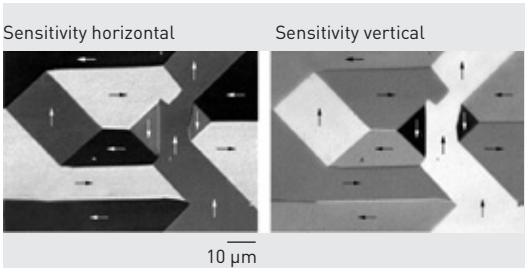
FeSi: Combination of high and low resolution images on non-oriented FeSi electrical steel sheet



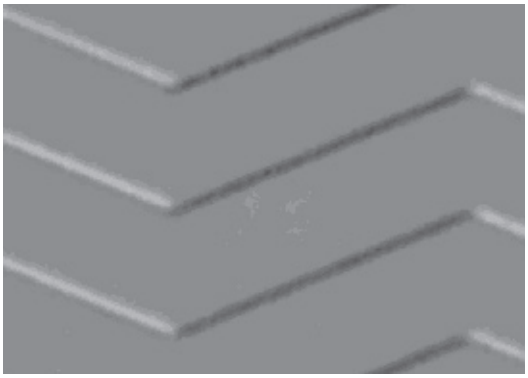
Hysteresis curve measurements: Depth selective hysteresis curve in $Ni_{81}Fe_{19}$/Cu/Co film



Longitudinal-transverse sensitivity:
Combination experiment with longitudinal and transverse sensitivity on (100)-FeSi surface



$Ni_{81}Fe_{19}$ stripe: Magnetic domain structure in 500 nm width nano-wire



evico magnetics GmbH provides instruments for magnetic analysis and imaging as well as novel synthesis tools for functional materials.

Our products are High Pressure Milling Vials with a Gas Temperature Monitoring System for the synthesis of magnetic powders and hydrogen storage materials as well as Magneto-Optical Kerr Microscopes for the in-situ observation of magnetic microstructures. In addition we offer scientific consultancy and expertise on magnetic and hydrogen storage materials supported by state of the art characterization facilities.

Advanced wide-field Kerr microscope for magnetic domain research.

The Kerr microscope can be used to study domains and magnetization processes in ferro- and ferrimagnetic materials at any magnification down to the resolution limit of optical microscopy. Dr. Jeffrey McCord and Dr. Rudolf Schäfer* who have long-lasting experience in the field have developed the microscope.

Reactive Ball Milling Vial with in-situ process monitoring.

A unique method for the synthesis of nanoscale functional materials and monitoring of hydrogenation reactions by reactive ball milling under high hydrogen atmosphere has been developed. It involves high-energy ball milling in an especially designed vial, allowing in-situ monitoring of temperature and of hydrogen pressure by incorporating a gas-temperature measurement system as well as a radio emitter into the system. Dr. Oliver Gutfleisch who has extensive knowledge in the field has developed the milling system.

Funded by six leading scientists of the Leibniz-Institute for Solid State and Materials Research, evico magnetics started its business in 2006 with high-end products developed and used at the IFW Dresden.
Since then our Kerr microscopes and high-pressure milling vials are well established and in use in numerous research and industrial laboratories all around the globe

A. Hubert, R. Schäfer*:
Magnetic Domains: The Analysis of Magnetic Microstructure, Springer, Berlin-Heidelberg-New York 1998

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