

# Application note

## Dose Painting



Annular Dark Field measurement\* of grating replica with latex spheres, with exposure mask applied.



"The Great Wave off Kanagawa," exposure mask.

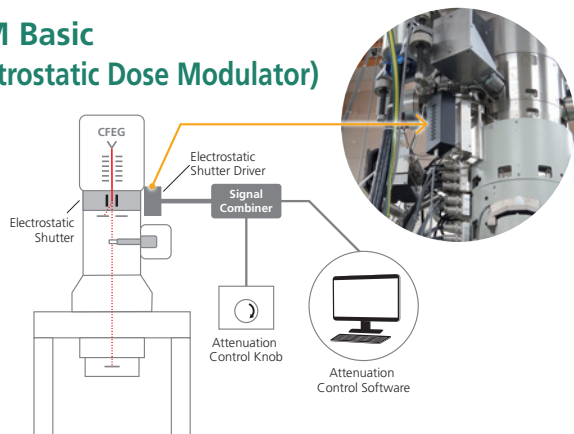
Dose Painting creates precise exposure patterns by synchronizing an electrostatic blanker to a STEM scan. Here, we demonstrate this capability by exposing Katsushika Hokusai's ukiyo-e, "The Great Wave off Kanagawa," onto a grating replica sample using a 200 keV electron beam in a JEM-ARM200F. As seen in the comparison between the original image and the Annular Dark Field image written by Dose Painting, the grayscale variations and fine structural details of each pixel are faithfully reproduced.

The pattern was applied in a TEM using the Dose Painter software, which is part of the Electrostatic Dose Modulator (EDM) Synchrony system from IDES, Inc. First, a color image of "The Great Wave off Kanagawa" was converted to a  $1,024 \times 1,024$ -pixel greyscale exposure mask in TIFF format using a free and open-source raster graphics editor GIMP. Next, Dose Painter synthesized the mask into a pulse sequence. EDM Synchrony directed the electrostatic blanker to control the exposure time at each pixel of a STEM scan. The dwell time was  $38.5 \mu\text{s}$  per pixel and the exposure area on the surface of the grating replica was approximately  $6.6 \mu\text{m} \times 6.6 \mu\text{m}$ .

This process can be executed on any TEM equipped with EDM Synchrony by IDES. This measurement was taken using Digital Micrograph 3 and DigiScan 3 by Gatan. JEOL TEM Center and FEMTUS™ are also supported.

\*Data courtesy of Lluís López Conesa, PhD, the Centres Científics i Tecnològics de la Universitat de Barcelona (CCiTUB).

## EDM Basic (Electrostatic Dose Modulator)



The Electrostatic Dose Modulator (EDM) is a fast beam blanking system with a pre-sample electrostatic deflector, including electronics and software control. With EDM, the 100,000x improvement in blanking speed immediately improves the clarity of data taken at fast exposure times. EDM can also attenuate electron illumination without affecting imaging conditions, giving TEM and STEM users exceptional control over the dose on their samples.

## Programmable STEM with EDM Synchrony



The optional Synchrony upgrade takes EDM's timing and synchronization capabilities to the next level. Synchrony can coordinate with a STEM controller, tracking the probe beam location as it scans across the sample. EDM's lightning-fast electrostatic blanking turns the beam on for a specified time at each pixel, or keeps the beam blanked to completely exclude sensitive regions from dose.

## Pulse System



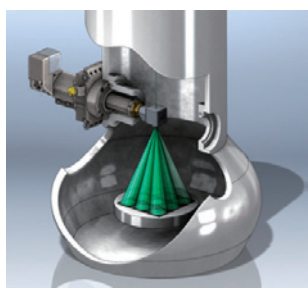
JEOL is pleased to offer Pulse for STEM. Pulse is a real time signal processor that enables digital imaging using standard analog STEM detectors. The device simply plugs in between your STEM detector and data acquisition system to deliver improved signal to noise ratios in your STEM images, particularly in low-dose or high-speed imaging modes.

## TEMPO



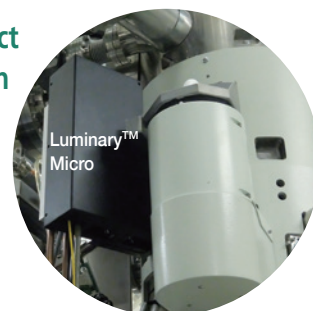
This is a completely new approach to STEM which inverts the typical approach to image formation by using the time required to reach a fixed number of electrons as the basis for pixel intensity rather than the number of electrons detected in a fixed amount of pixel dwell time. Once the desired number of electrons have been counted in a given pixel, the electron beam can then be rapidly blanked resulting in a significant reduction in overall dose applied to a specimen.

## Relativity™ Electrostatic Subframing System



The IDES Relativity™ Electrostatic Subframing System multiplies the frame rate of cameras on JEOL TEMs. Microscopes equipped with Relativity™ achieve exceptional time resolution, data throughput, and advanced automation capabilities.

## Luminary™ Micro Compact Specimen Photoexcitation System



Luminary™ Micro is a Compact Specimen Photoexcitation System (CPXS) for JEOL TEMs. With Luminary™ Micro, users can study laser-induced phenomena in situ using fast cameras. Combined with IDES/JEOL EDM fast shutter and/or Relativity™ subframing systems, Luminary™ Micro allows users to perform time-resolved studies using pump-probe methods on the microsecond time scale.

EM-IDES-003

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\* Appearance and specifications are subjected to change without notice.

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