



Semiconductor Equipment  
Electron Beam Lithography Systems

Solutions for Innovation

# JBX Series



JEOL Ltd.

*In order to increase the production efficiency  
JEOL offers electron beam lithography systems  
for a variety of applications.*

*JEOL has supplied a complete line of systems for 50 years, since the development of its first  
Electron Beam Lithography (EBL) system in 1967.*

*Today, JEOL is the world's top supplier of EBL systems. Our customer's applications of the  
systems range from mask/reticle production for high-end devices and nano-lithography research to  
ultrafine, direct write exposures of communication devices in their factories.*

*JEOL will continue pursuing higher writing accuracy, higher throughput and easier operation  
in advancing the development of advanced EBL systems.*



JBX-8100FS

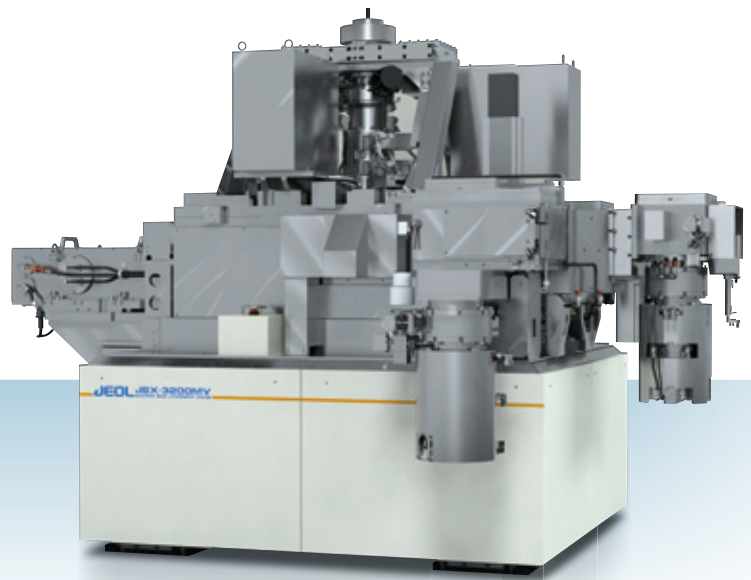


JBX-9

*cy and development speed of devices,  
stems optimized*



500FS



JBX-3200MV  
& JBX-3050MV

# JBX-8100FS

## Electron Beam Lithography System

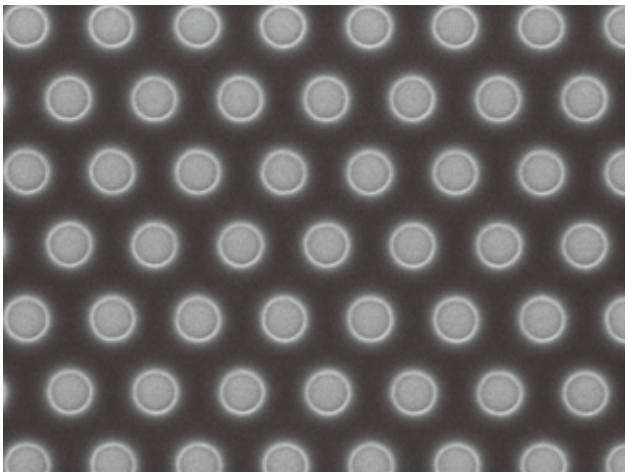
- Self contained and compact
- Extreme accuracy while maintaining high throughput
- Built with JEOL's renowned Electron Optics for ultimate stability
- Easy operation to obtain excellent results.
- Upgradeable and modular platform to enable you to improve the performance as your research progresses.

### Principal Specifications

Writing method:	Spot beam, vector scan & step and repeat
Accelerating voltage :	100 kV/ 50 kV/ 25 kV
Electron beam emitter :	ZrO/W Schottky
Substrate size :	Maximum 200 mm wafer
Minimum line width :	≤8 nm @ field center
Field stitching accuracy :	±20 nm @ 1 mm field
Overlay accuracy :	±20 nm @ 1 mm field
Scan speed :	125 MHz



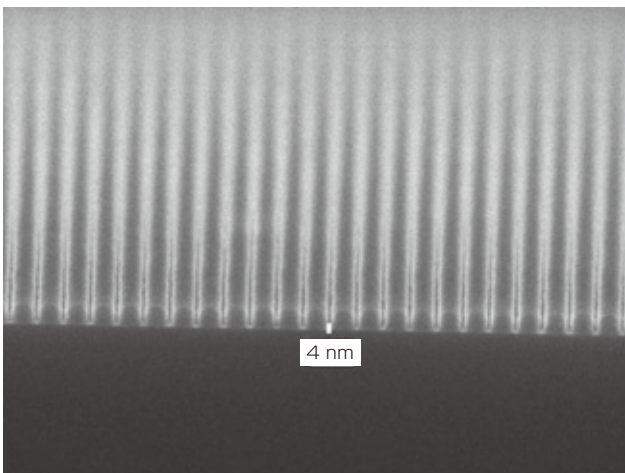
Photonic Pattern



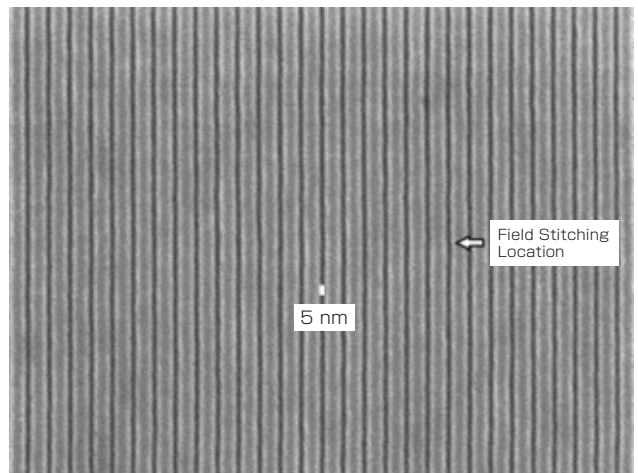
Grating Pattern



4 nm Line Pattern



Field Stitching Pattern



# JBX-9500FS

## High Throughput, High Precision Direct Writing EB Lithography System

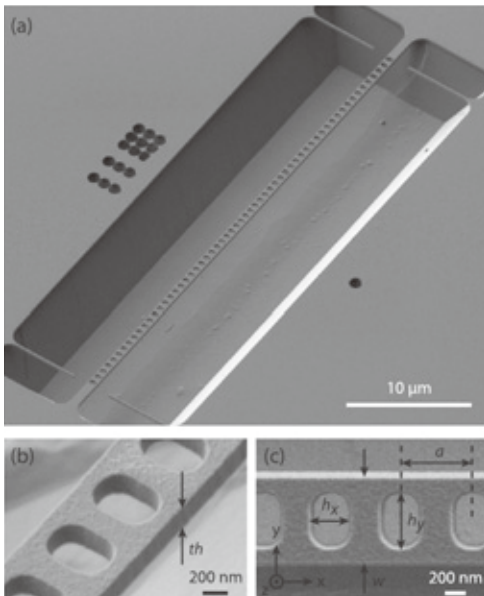
- State of the art, high throughput high precision spot beam system.
- 100 kV accelerating voltage
- High resolution Schottky emitter
- Up to 300 mm wafer loadable
- High performance field stitching and overlay accuracy
- Application from nano technology to leading edge device production

### Principal Specifications

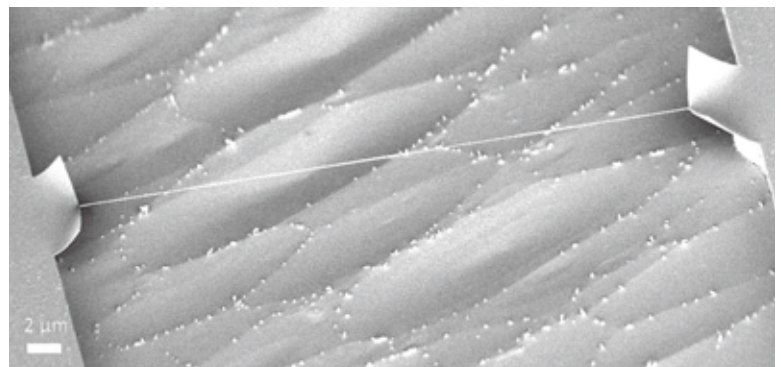
Writing method :	Spot beam, vector scan & step and repeat
Accelerating voltage :	100 kV
Electron beam emitter :	ZrO/W Schottky
Substrate size :	Maximum 300 mm wafer
Minimum line width :	$\leq 10$ nm @ 1 mm field
Field Stitching accuracy :	$\pm 10$ nm @ 1 mm field
Overlay accuracy :	$\pm 11$ nm @ 1 mm field
Scan speed :	120 MHz
Position accuracy within plate :	$\pm 11$ nm @ 60 mm



High-Q Silicon Carbide Photonic-Crystal Cavities. Jonathan Lee, et al., University of Rochester



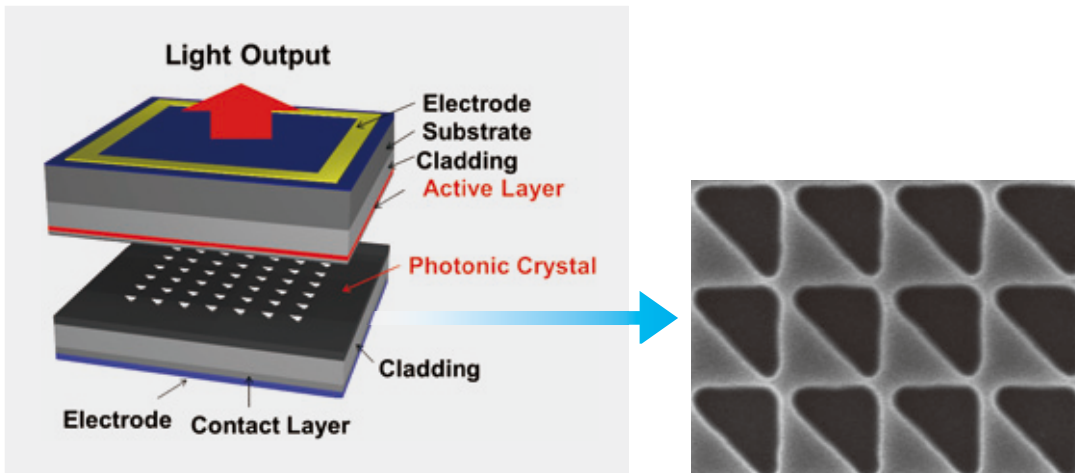
Ultra-thin Superconducting Film Coated Silicon Nitride Nanowire Resonators for Low-Temperature Applications. Abhilash Sebastian, Cornell University



Alan R. Bleier (Cornell NanoScale Facility) JEOL Electron Beam Lithography at Cornell

## Application Examples

### Photonic crystal laser



Courtesy of S. Noda (Kyoto University)  
K. Hirose *et al.*, *Nature Photonics* **8**, 406-411 (2014)

SEM image

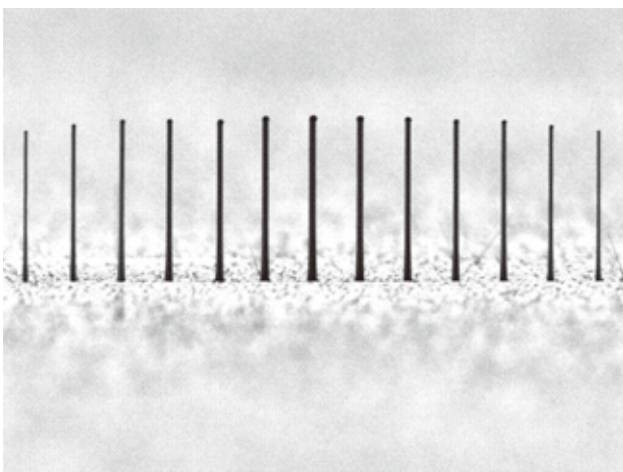
### Selective-area growth of InGaAs nanowires on Si(111)



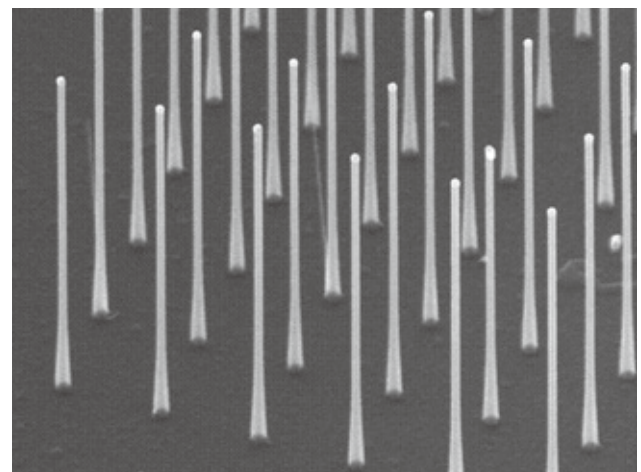
Courtesy of T. Fukui (Hokkaido University)  
K. Tomioka *et al.*, *Nature* **488**, 189-192 (2012)

Scanning electron microscope (SEM) image showing selective-area growth of InGaAs nanowires on Si: vertically aligned nanowires were grown on a Si(111) substrate. The surface between the nanowires is covered with an  $\text{SiO}_2$  film. The nanowires are 90 nm in diameter and 760 nm in height.

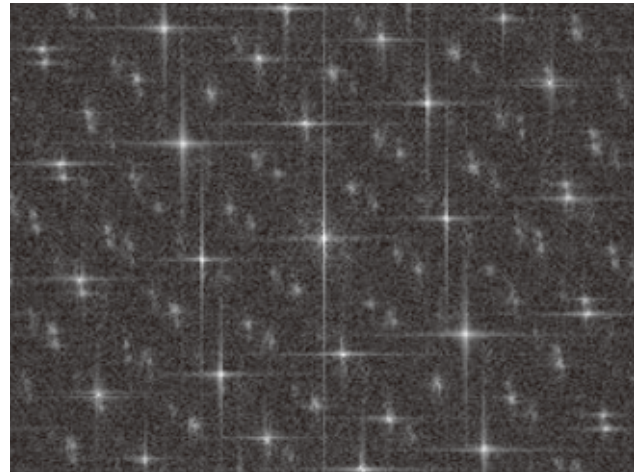
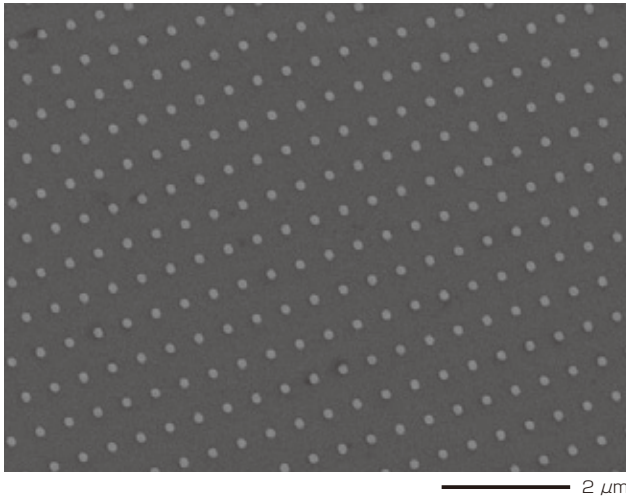
### Ge nanowires grown from lithographically patterned Au dots



Courtesy of S. Dayeh (University of California, San Diego) and T. Picraux (Los Alamos National Laboratory).  
S. Dayeh *et al.*, *Nano Lett.* **10**, 4032 (2010)

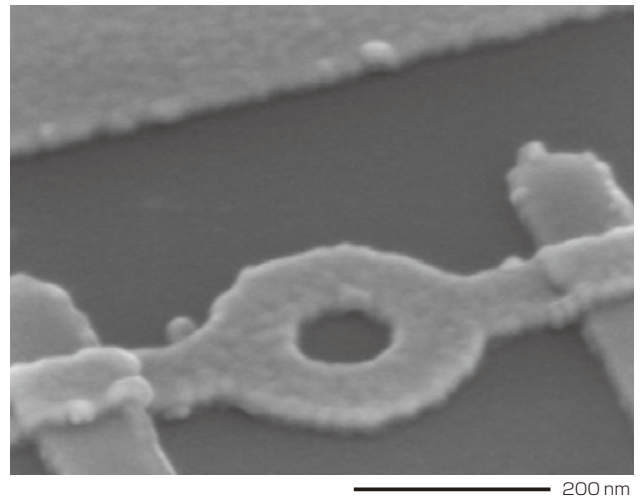
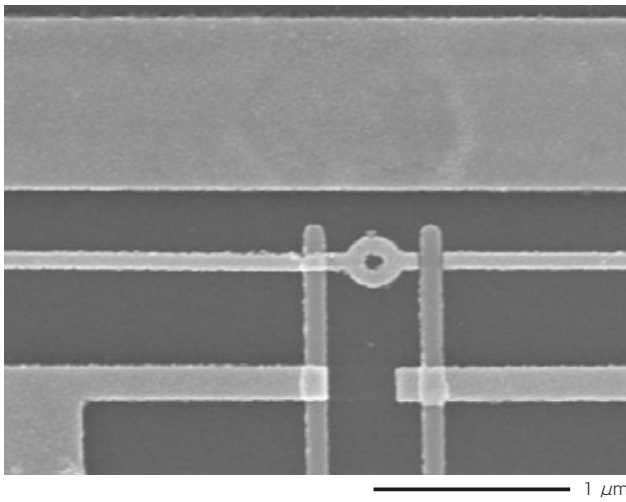


### Exchange bias in large scale nanodot arrays



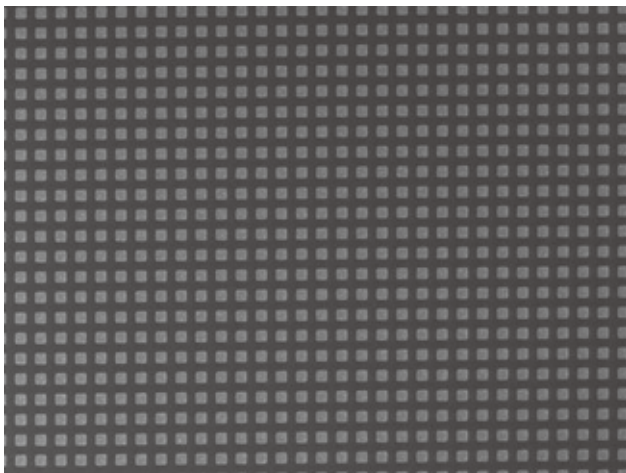
Courtesy of E. Linfield (University of Leeds) and A. Hirohata (University of York).

### Non-magnetic nano-ring for spin-current operation



Courtesy of E. Linfield (University of Leeds) and A. Hirohata (University of York).

### High current exposure



1 μm square pattern (100 kV, 100 nA).

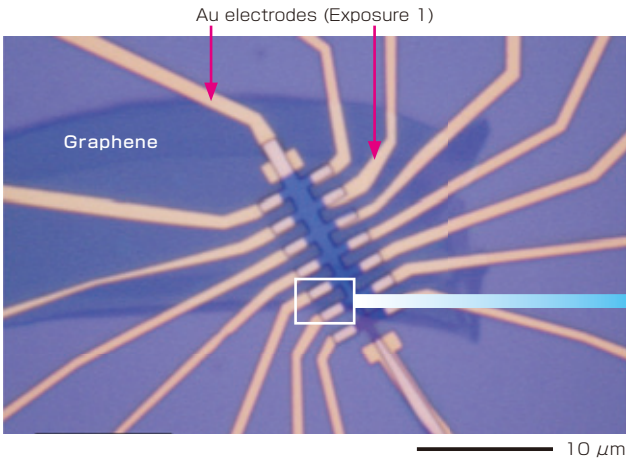


200 nm line pattern (100 kV, 100 nA).

Application Examples

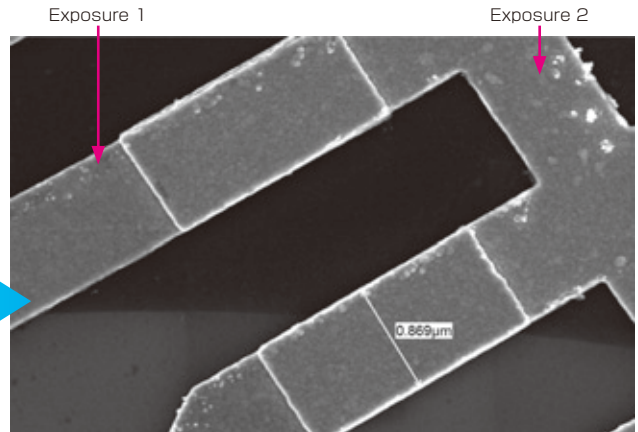
Electrodes patterning on a Graphene

Image of an optical microscope

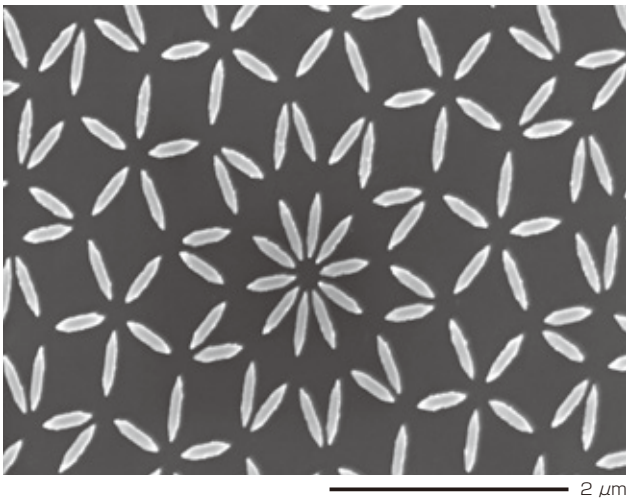


Courtesy of Graphene Research Centre, National University of Singapore.

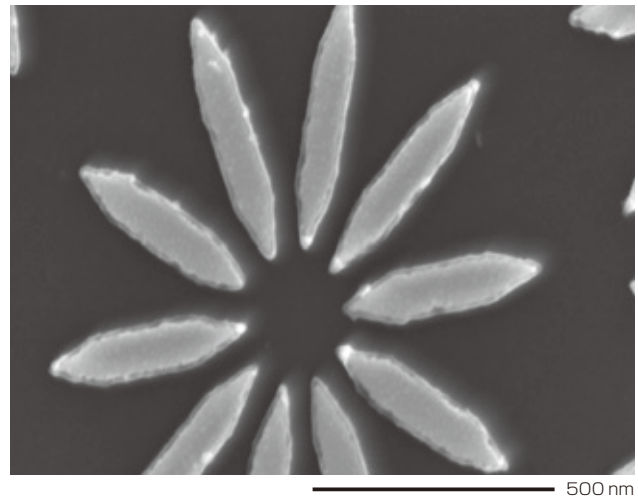
After lift-off Au at gate image of SEM



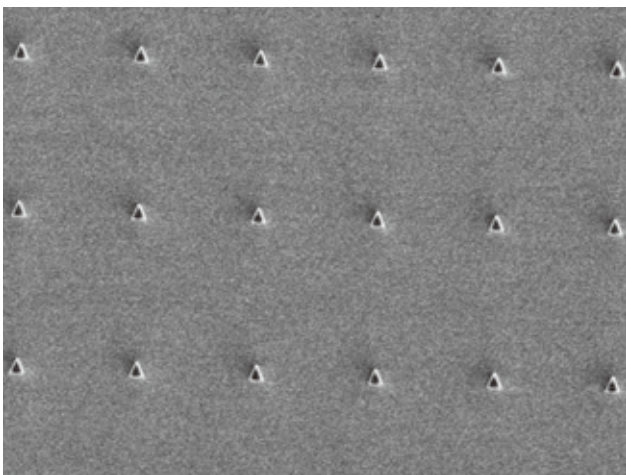
Penrose tile ice array of nanomagnet



Courtesy of J. Morgan, C. Marrows (University of Leeds), and A. Stein (Center for Functional Nanomaterials, Brookhaven National Laboratory).

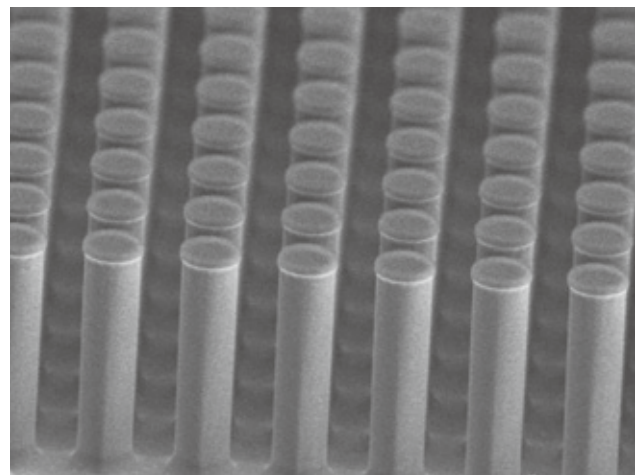


HSQ triangular pillars on diamond substrate



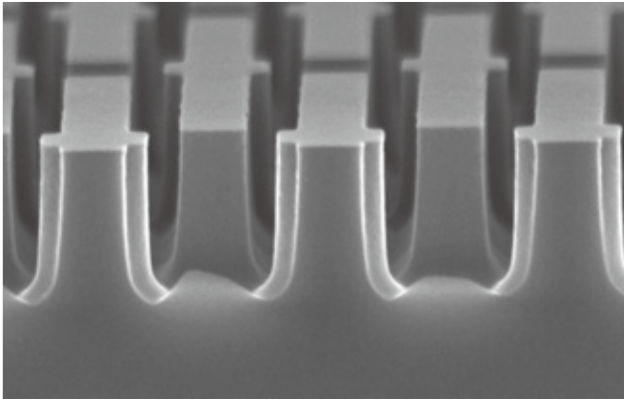
Courtesy of L. Li (Columbia University) and D. Englund (Massachusetts Institute of Technology).

Photonic crystal pattern etched in silicon



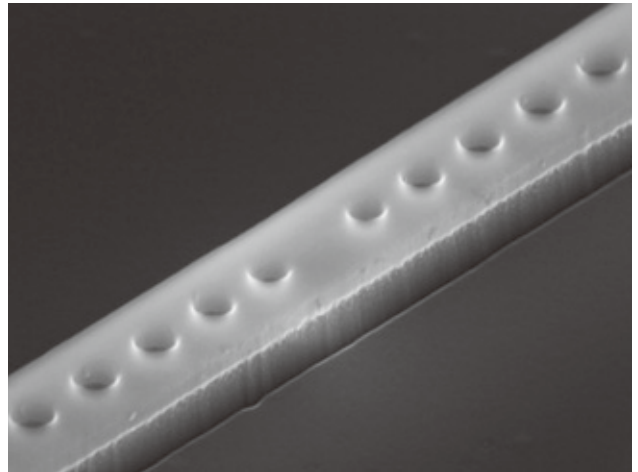
Courtesy of J. Beck and I. Kyriassis (Columbia University).

Etched Si mesa brick-wall pattern optimized for minimal RIE lag-induced depth variation for photovoltaic application



Courtesy of D. Johnston (Center for Functional Nanomaterials, Brookhaven National Laboratory). 100 nm

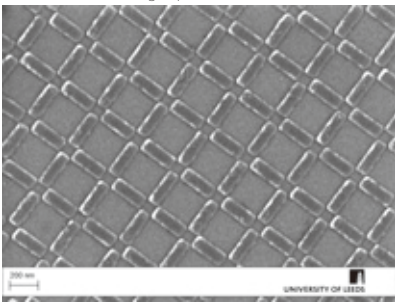
1-D photonic crystal silicon waveguide cavity



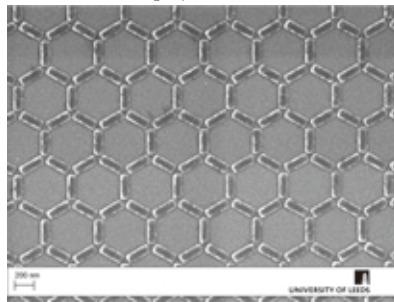
Courtesy of R. Grote, and R. Osgood (Columbia University). 1 μm

Spin ice array of nanomagnet

CoFeB square spin ice pattern  $\text{Si}_3\text{N}_4$  membrane



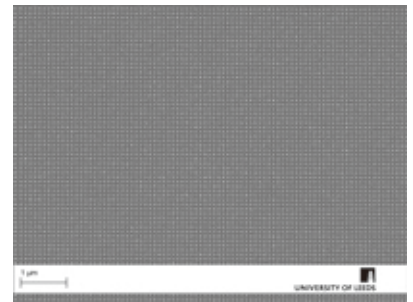
CoFeB Kagome spin ice pattern  $\text{Si}_3\text{N}_4$  membrane



Courtesy of M. Rosamond and S. Morley (University of Leeds).

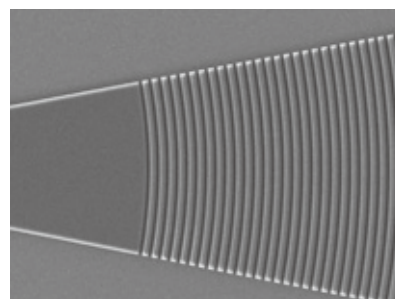
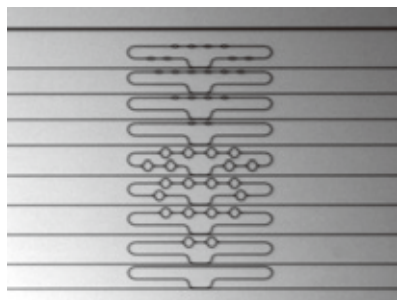
Dot pattern

20 nm gold dots at 100 nm pitch written "on the fly"



Courtesy of M. Rosamond (University of Leeds).

Waveguide



Courtesy of R. Bojko (Nanofabrication Facility, University of Washington).

# JBX-3200MV & JBX-3050MV

De-Facto Standard Tools for Wide Range Node Mask Production

## Principal Specifications

Writing Method : VSB, Vector Scan, Step & Repeat  
Electron Beam (EB) : 50 kV

### JBX-3200MV Series

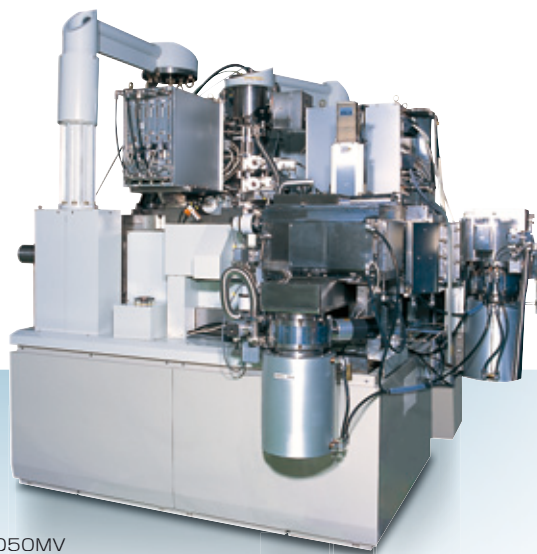
CD uniformity :  $\leq 3$  nm (3 s)  
Image Placement :  $\leq 5$  nm (3 s)



JBX-3200MV



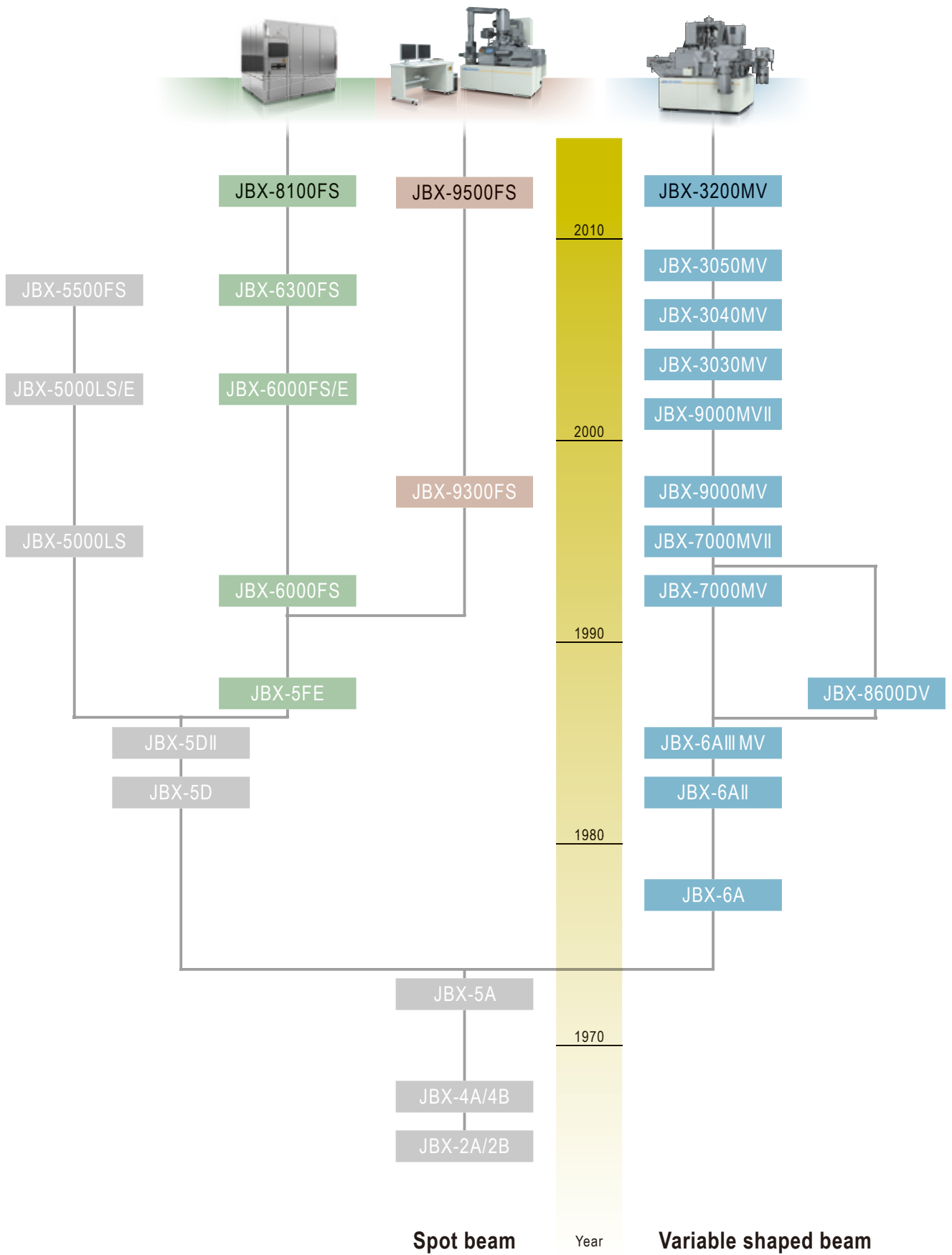
JBX-3050MV



### JBX-3050MV Series

CD uniformity :  $\leq 3.5$  nm (3 s)  
Image Placement :  $\leq 7$  nm (3 s)

# Development history of JEOL E-Beam lithography system



\*Specifications subject to change without notice.

Certain products in this brochure are controlled under the "Foreign Exchange and Foreign Trade Law" of Japan in compliance with international security export control. JEOL Ltd. must provide the Japanese Government with "End-user's Statement of Assurance" and "End-user Certificate" in order to obtain the export license needed for export from Japan. If the product to be exported is in this category, the end user will be asked to fill in these certificate forms.



3-1-2 Musashino Akishima Tokyo 196-8558 Japan Sales Division Tel. +81-3-6262-3560 Fax. +81-3-6262-3577  
www.jeol.com ISO 9001 • ISO 14001 Certified

**ARGENTINA**  
COASIN S.A.C.I.yF.  
Virrey del Pino 4071,  
C1430CAM-Buenos Aires  
Argentina  
Tel. 54-11-4552-3185  
Fax. 54-11-4555-3321

**AUSTRALIA & NEW ZEALAND**  
JEOL (AUSTRALASIA) Pty.Ltd.  
Suite 1, L2 18 Aquatic Drive  
+ Frenchs Forest NSW 2086  
Australia  
Tel. 61-2-9451-3855  
Fax. 61-2-9451-3822

**AUSTRIA**  
JEOL (GERMANY) GmbH  
Gute Aenger 30  
85356 Freising, Germany  
Tel. 49-8161-9845-0  
Fax. 49-8161-9845-100

**BANGLADESH**  
A.Q. CHOWDHURY SCIENCE & SYNERGY PVT. LTD.  
87, Suhrawardy Avenue, Floor 2  
Baridhara, Dhaka1212  
Bangladesh  
Tel. 8802-9862272, 8953450, 8953501  
Fax. 8802-9854428

**BELGIUM**  
JEOL (EUROPE) B.V.  
Planet II, Gebouw B  
Leuvensesteenweg 542,  
B-1300 Zaventem  
Belgium  
Tel. 32-2-720-0560  
Fax. 32-2-720-6134

**BRAZIL**  
JEOL Brasil Instrumentos Cientificos Ltda.  
Av. Jabouass, 2958 5º andar conjunto 52 ;  
04046-500 Sao Paulo, SP  
Brazil  
Tel. 55-11-5070-4000  
Fax. 55-11-5070-4110

**CANADA**  
JEOL CANADA, INC.  
3275 fare Rus, Local #8  
St-Hubert, QC J3Y-8Y6, Canada  
Tel. 1-450-676-8776  
Fax. 1-450-676-8694

**CHINA**  
JEOL (BEIJING) CO., LTD.  
Zhongkezyuan Building South Tower 2F,  
Zhongguancun Nanshan Street No. 6,  
Haidian District, Beijing, P.R.China  
Tel. 86-10-6804-6321  
Fax. 86-10-6804-6324

**JEOL (BEIJING) CO., LTD., SHANGHAI BRANCH**  
2F-BC Room, Building A, Mingji Business Plaza,  
No.207 Songhong Road, Changning District,  
Shanghai 200335, P.R.China  
Tel. 86-21-6248-4487  
Tel. 86-21-5836-6350  
Fax. 86-21-5836-3668

**JEOL (BEIJING) CO., LTD., GUANGZHOU BRANCH**  
N1601, World Trade Center Building,  
Guangdong Prov., 510095, P.R.China  
Tel. 86-20-8778-7848  
Fax. 86-20-8778-4268

**JEOL (BEIJING) CO., LTD., WUHAN BRANCH**  
Room A2118, Zhongshang Plaza Office Bldg.,  
No. 7 Zhongnan Road, Wuhan,  
Hubei, 430070, P.R.China  
Tel. 86-27-8715-2567  
Fax. 86-27-8713-2567

**JEOL LTD. (BEIJING) CO., LTD., CHENGDU BRANCH**  
1807A Zongfu Building,  
NO. 35 Zhongfu Road, Chengdu, Sichuan, 610016  
P.R. China  
Tel. 86-28-86622554  
Fax. 86-28-86622564

**EGYPT**  
JEOL SERVICE BUREAU  
3rd Fl. Nile Center Bldg., Nawal Street,  
Dokki, (Cairo), Egypt  
Tel. 20-2-3335-7220  
Fax. 20-2-3338-4186

**FRANCE**  
JEOL (EUROPE) SAS  
Espace Claude Monet, 1 Allée de Giverny  
78290, Croissy-sur-Seine, France  
Tel. 33-13015-3737  
Fax. 33-13015-3747

**GERMANY**  
JEOL (GERMANY) GmbH  
Gute Aenger 30  
85356 Freising, Germany  
Tel. 49-8161-9845-0  
Fax. 49-8161-9845-100

**GREAT BRITAIN & IRELAND**  
JEOL (U.K.) LTD.  
JEOL House, Silver Court, Watchmead,  
Welwyn Garden City, Herts AL7 1LT, U.K.  
Tel. 44-1707-377117  
Fax. 44-1707-373254

**GREECE**  
N. ASTERADIS S.A.  
56-58,S. Trikoupí Str. P.O. Box 26140  
GR-10022, Athens, Greece  
Tel. 30-1-823-5383  
Fax. 30-1-823-9567

**HONG KONG**  
FARMING LTD.  
Unit No. 1009, 10/F., Prosperity  
663 King's Road, North Point, Hong Kong  
Tel. 852-2815-7299  
Fax. 852-2581-4635

**INDIA**  
JEOL INDIA PVT. LTD.  
Unit No.305, 3rd Floor,  
ABW Elegance Tower,  
Jasoda District Centre,  
New Delhi 110 025, India  
Tel. 91-11-4695-8000  
Tel. 91-11-4595-8005  
Tel. 91-11-4595-8017

**JEOL INDIA PVT. LTD. Mumbai Office**  
214 E Square, Subhash Road,  
Vile Parle (EAST),  
Mumbai 400 057, India  
Tel. 91-22-2612-9387

**JEOL INDIA PVT. LTD. Bangalore Office**  
125, Brigade Road,  
Unit No.402, Level 4, Palms Square,  
Bangalore-560025, India  
Tel. 91-80-4375-3351

**JEOL INDIA PVT. LTD. Kolkata Office**  
Regus, The Legacy, 25 / A,  
Shakespeare Sarani,  
Kolkata - 700017, India  
Tel. 91-98-3023-0484

**JEOL INDIA PVT. LTD. Hyderabad Office**  
422, Regus Solitaire Business centre,  
1-10-39 to 44, level 4, Gumdelli Towers, Old Airport Road,  
Begumpet, Hyderabad - 500016, India  
Tel. 91-40-6704-3708

**INDONESIA**  
PT. TEKNOABindo Perita Perkasa  
Komplek Gading Bukit Indah Blok I/11  
Jl. Bukit Gading Raya Kelapa Gading Permai,  
Jakarta 14240, Indonesia  
Tel. 62-21-45847057/58  
Fax. 62-21-45942729

**ITALY**  
JEOL (ITALIA) S.p.A.  
Palazzo Paschini - Milano 3 City,  
Via Ludovico Il Moro, 6/A  
20080 Basiglio(MI) Italy  
Tel. 39-02-9041431  
Fax. 39-02-90414343

**KOREA**  
JEOL KOREA LTD.  
Dongwoo Bldg. 7F, 1443, Yangjae Daero,  
Gangdong-Gu, Seoul, 05355, Korea  
Tel. 82-2-511-5501  
Fax. 82-2-511-2635

**KUWAIT**  
Ashraf & CO. Ltd.  
P.O.Box 3555 Safat 13036, Kuwait  
Tel. 965-1803151  
Fax. 965-2433573

**MALAYSIA**  
JEOL (MALAYSIA) SDN.BHD.  
508, Block A, Level 5,  
Kelana Business Center,  
97, Jalan SS 7/2, Kelana Jaya,  
47301 Petaling Jaya, Selangor, Malaysia  
Tel. 60-3-7492-7722  
Fax. 60-3-7492-7723

**MEXICO**  
JEOL DE MEXICO S.A. DE C.V.  
Arkansas 11 Piso 2  
Colonia Napoles  
Delegacion Benito Juarez, C.P. 03810  
Mexico D.F., Mexico  
Tel. 52-5-55-211-4511  
Fax. 52-5-55-211-0720

**Middle East**  
JEOL GULF FZCO  
P.O. Box No. 371107  
Dubai Airport Free Trade Zone West Wing 5WA No. G12,  
Dubai, UAE  
Tel. 971-4-609-1497  
Fax. 971-4-609-1498

**PAKISTAN (Karachi)**  
ANALYTICAL MEASURING SYSTEM (PVT) LTD. (AMS LTD.)  
14-C Main Sehar Commercial Avenue Lane 4,  
Khayaban-e-Sehar,  
D.I.A.V.II, Karachi-75500, Pakistan  
Tel. 92-21-35345581/35340747  
Fax. 92-21-35345582

**PANAMA**  
PROMED S.A.  
Parque Industrial Costa del Este  
Urbanizacion Costa del Este  
Apartado 0816-01755, Panama, Panama  
Tel. 507-303-3100  
Fax. 507-303-3115

**PHILIPPINES**  
JATEC Philippines Corporation  
28 Floor, The Enterprise Center Tower 2,  
Ayala Avenue corner Paseo de Roxas,  
Ergy, San Lorenzo, Makati City, 1228 Philippines  
Tel. (632) 849 3904

**PORTUGAL**  
Izasa Portugal Lda.  
R. do Proletariado, 1  
2790-138 CARNAXIDE, Portugal  
Tel. 351-21-424-73-00  
Fax. 351-21-419-60-20

**QATAR**  
Marmal Trading Company W.L.L.  
ALI Emadi Complex  
Salwa Road P.O.Box 76, Doha, Qatar  
Tel. +974 4455-8216  
Fax. +974 4455-8214

**RUSSIA**  
JEOL (RUS) LLC  
Krasnoproletskaya Street, 16,  
Bld. 2, 127473, Moscow,  
Russian Federation  
Tel. 7-495-748-7791/7792  
Fax. 7-495-748-7793

**SAUDI ARABIA**  
ABDULREHMAN ALGOSAIBI G.T.C. (Riyadh)  
Algosaibi Building-Old Airport Road  
P.O. Box 215, Riyadh-11411, Saudi Arabia  
Tel. 966-1-477-7932

**SCANDINAVIA**  
SWEDEN  
JEOL (Nordic) AB  
Hammarbacken 6A, Box 716, 191 27 Sollentuna  
Sweden  
Tel. 46-8-28-2800  
Fax. 46-8-29-1647

**SINGAPORE**  
JEOL ASIA PTE.LTD.  
2 Corporation Road  
#01-12 Corporation Place  
Singapore 618494  
Tel. 65-6566-9889  
Fax. 65-6565-7552

**SOUTH AFRICA**  
ADI Scientific (Pty) Ltd.,  
370 Angus Centre,  
Northlands Business Park, 29 Newmarket Road  
Northridge, Randburg, Republic of South Africa  
Tel. 27-11-462-1363  
Fax. 27-11-462-1466

**SPAIN**  
IZASA Scientific SLU,  
Argoneses, 13, 28108 Alcobendas,  
Madrid, Spain  
Tel. 34 902 20 30 80  
Fax. 34 902 20 30 81

**SWITZERLAND**  
JEOL (GERMANY) GmbH  
Gute Aenger 30  
85356 Freising, Germany  
Tel. 49-8165-77946  
Fax. 49-8165-77512

**TAIWAN**  
JIE DONG CO., LTD.  
7F, 112, Chung Hsiao East Road,  
Section 1, Taipei, Taiwan 10023 (R.O.C.)  
Tel. 886-2-2395-2979  
Fax. 886-2-2322-4655

For NMR & Mass Spectrometer Products  
Wisestron Technologies Corp.  
No.8-2, No.77, Sec-2, Zhonghua E Rd.,  
East Dist., Tainan City 701, Taiwan (R.O.C.)  
Tel. 886-6-289-1943  
Fax. 886-6-289-1743

For Mass Spectrometer Products  
TechMax Technical Co., Ltd.  
5F., No.11, Wuqian 2nd Rd., Wugu Dist.,  
New Taipei City 248, Taiwan (R.O.C.)  
Tel. 886-2-8990-1779  
Fax. 886-2-8990-2559

For Semiconductor Products:  
JEOL TAIWAN SEMICONDUCTORS LTD.  
2F-2, No. 192, Dongguang Rd,  
East Dist., Hsinchu City 30069,  
Taiwan (R.O.C.)  
Tel. 886-3-571-5656  
Fax. 886-3-571-5151

**THAILAND**  
BECTHAI BANGKOK EQUIPMENT & CHEMICAL CO., Ltd.  
300 Phaholyothin Rd, Phayathai, Bangkok 10400,  
Thailand  
Tel. 66-2-615-2929  
Fax. 66-2-615-2350/2351

**JEOL ASEAN TECHNICAL CENTER (JATC)**  
MTEC building room 533  
114 Moo9, Thailand Science Park  
Phaholyothin Rd., Klong 1, Klong Luang,  
Pathumthani 12120  
THAILAND  
Tel. 66-2-615-2350  
Fax. 66-2-564-7738

**THE NETHERLANDS**  
JEOL (EUROPE) B.V.  
Lireweg 4, NL-2153 PH Nieuw-Vennep,  
The Netherlands  
Tel. 31-252-625500  
Fax. 31-252-625501

**TURKEY**  
Tekser A.S.  
Kartal Cad. No: 55/3 Inonu Wah.,  
Atasehir 34755, Istanbul, Turkey  
Tel. 90-216-5735470  
Fax. 90-216-5736475

**USA**  
JEOL USA, INC.  
11 Dearborn Road, Peabody, MA 01960, U.S.A.  
Tel. 1-978-535-5900  
Fax. 1-978-536-2205/2206

**JEOL USA, INC. WEST OFFICE**  
5653 Stoneridge Drive Suite #110  
Pleasanton, CA 94588, U.S.A.  
Tel. 1-925-737-1740  
Fax. 1-925-737-1749

**VENEZUELA**  
GOMSA Service and Supply C.A.  
Urbanizacion Montalban II  
- Residencias Don Andres - Piso 7 - Apartamento 74  
Avenida 3, entre calles 7 y 6  
Montalban, Caracas, Venezuela  
Tel. 58-212-443-4342  
Fax. 58-212-443-4342

**VIETNAM**  
TECHNICAL MATERIALS AND RESOURCES  
IMPORT-EXPORT JOINT STOCK COMPANY(REXCO)  
Hanoi Branch  
SALES & SERVICE  
155-157 Lang Ha Street, Dong Da District, Hanoi, Vietnam  
Tel. +84 (43) 562 0516  
Fax. +84 (43) 853 2511