

Materials List for:

Characterization of Electrode Materials for Lithium Ion and Sodium Ion Batteries Using Synchrotron Radiation Techniques

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Materials

Name	Company	Catalog Number	Comments
Equipment			
Inert atmosphere glovebox	Vacuum Atmospheres	Custom order, contact vendors	Used during cell assembly and to store alkali metals and moisture sensitive components. (http://vac-atm.com)
Inert atmosphere glovebox	Mbraun		Various sizes (single, double) available, many options such as mini or heated antechambers oxygen/water removal systems, shelving, electrical feedthroughs, etc. (http://www.mbraunusa.com)
X-ray powder diffractometer (XRD)	Panalytical	X'Pert Powder	X'Pert is a modular system. Many accessories available for specialized experiments. (www.panalytical.com)
X-ray powder diffractometer (XRD)	Bruker	Bruker D2 Phaser	Bruker D2 Phaser is compact and good for routine powder analyses. (www.bruker.com)
Scanning Electron Microscope (SEM)		JSM7500F	High resolution field emission scanning electron microscope with numerous customizable options. JEOL (http://www.jeolusa.com) Low cost tabletop versions also available. Contact vendor for options.
Pouch Sealer	VWR	11214-107	Used to seal pouches for <i>in situ</i> work. (https://us.vwr.com)
Manual crimping tool	Pred Materials	HSHCC-2016, 2025, 2032, 2320	Used to seal coin cells. Match size to coin cell hardware. (www.predmaterials.com)
Coin cell disassembling tool	Pred Materials	Contact vendor	Used to take apart coin cells to recover electrodes for <i>ex situ</i> work. Needlenose pliers can also be used. Cover ends with Teflon tape to avoid shorting cells. (www.predmaterials.com)
Film casting knives	BYK Gardner	4301, 4302, 4303, 4304, 4305, 2325, 2326, 2327, 2328, 2329	Used to cast electrodes films from slurries. Different sizes available, with either metric or English gradations. Bar film or Baker-type applicators and doctor blades

			are less versatile but lower cost options. Can be used by hand or with automatic film applicators. (https://www.byk.com)
Doctor blades, Baker applicators	Pred Materials	Baker type applicator and doctor blade. Film casting knives also available.	Used to cast electrodes films from slurries. Different sizes available, with either metric or English gradations. Bar film or Baker-type applicators and doctor blades are less versatile but lower cost options. Can be used by hand or with automatic film applicators. (www.predmaterials.com)
Automatic film applicator	BYK Gardner	2101, 2105, 2121, 2122	Optional. Used with bar applicators, doctor blades, or film casting knives for automatic electrode film production. Films can also be made by hand but are less uniform. (https://www.byk.com)
Automatic film applicator	Pred Materials	Contact vendor	Optional. Used with bar applicators, doctor blades, or film casting knives for automatic electrode film production. Films can also be made by hand but are less uniform. (www.predmaterials.com)
Potentiostat/Galvanostat	Bio-Logic Science Instruments	VSP	Portable 5 channel computer-controlled potentiostat/galvanostat used to cycle cells for <i>in situ</i> experiments. (http://www.bio-logic.info)
Potentiostat/Galvanostat	Gamry Instruments	Reference 3000	Portable single channel computer-controlled potentiostat/galvanostat used to cycle cells for <i>in situ</i> experiments. (www.gamry.com)
The Area Diffraction Machine		Free download	Used for analysis of 2D diffraction data. Mac and Windows versions available. http://code.google.com/p/areadiffractionmachine/
IFEFFIT		Free download	Suite of interactive programs for XAS analysis, including Hephaestus, Athena, and Artemis. Available for Mac, Windows, and UNIX. http://cars9.uchicago.edu/ifeffit/
SIXPACK		Free download	XAS analysis program that builds on IFEFFIT. Windows and Mac versions. http://home.comcast.net/~sam_webb/sixpack.html
CelRef		Free download	Graphical unit cell refinement. Windows only. http://www.ccp14.ac.uk/tutorial/lmgp/celref.htm and http://www.ccp14.ac.uk/ccp/web-mirrors/lmgp-laugier-bochu/
Reagent/Material			
Electrode active materials	various		Synthesized in-house or obtained from various suppliers.
Synthetic flake graphite	Timcal	SFG-6	Conductive additive for electrodes. (www.timcal.com)

Acetylene black	Denka	Denka Black	Conductive additive for electrodes. (http://www.denka.co.jp/eng/index.html)
1-methyl-2-pyrrolidinone (NMP)	Sigma-Aldrich	328634	Used to make electrode slurries. (www.sigmaaldrich.com)
Al current collectors	Exopack	z-flo 2650	Carbon-coated foils. Coated on one side. (http://www.exopackadvancedcoatings.com)
Al current collectors	Alfa-Aesar	10558	0.025 mm (0.001 in) thick, 30 cm x 30 cm (12 in x 12 in), 99.45% (metals basis), uncoated (http://www.alfa.com)
Cu current collectors	Pred Materials	Electrodeposited Cu foil	For use with anode materials for Li-ion batteries. (www.predmaterials.com)
Lithium foil	Rockwood Lithium	Contact vendor	Anode for half cells. Available in different thicknesses and widths. Reactive and air sensitive. Store and handle in an inert atmosphere glovebox under He or Ar (reacts with N ₂). (www.rockwoodlithium.com)
Lithium foil	Sigma-Aldrich	320080	Anode for half cells. Available in different thicknesses and widths. Reactive and air sensitive. Store and handle in an inert atmosphere glovebox under He or Ar (reacts with N ₂). (www.sigmaaldrich.com)
Sodium ingot	Sigma-Aldrich	282065	Anodes for half cells. Can be extruded into foils. Reactive and air sensitive. Store and handle in an inert atmosphere glovebox under He only. (www.sigmaaldrich.com)
Electrolyte solutions	BASF	Selectlyte P-Series contact vendor	Contact vendor for desired formulations. (http://www.catalysts.basf.com/p02/USWeb-Internet/catalysts/en/content/microsites/catalysts/prods-inds/batt-mats/electrolytes)
Dimethyl carbonate (DMC)	Sigma-Aldrich	517127	Used to wash electrodes for <i>ex situ</i> experiments. (www.sigmaaldrich.com)
Microporous separators	Celgard	2400	Polypropylene membranes (http://www.celgard.com)
Coin cell hardware (case, cap, gasket)	Pred Materials	CR2016, CR2025, CR2320, CR2032	Match size to available crimping tool, Al-clad components also available. (www.predmaterials.com)
Wave washers	Pred Materials	SUS316L	(www.predmaterials.com)
Spacers	Pred Materials	SUS316L	(www.predmaterials.com)
Ni and Al pretaped tabs	Pred Materials	Contact vendor	Sizes subject to change. Inquire about custom orders. (www.predmaterials.com)
Polyester pouches	VWR	11214-301	Used to seal electrochemical cells for <i>in situ</i> work. Avoid heavy duty pouches because of strong signal interference. (https://us.vwr.com)
Kapton film	McMaster-Carr	7648A735	Used to cover electrodes for <i>ex situ</i> experiments, 0.0025 in thick (www.mcmaster.com)

Helium, Argon and 4-10% hydrogen in helium or argon	Air Products	contact vendor for desired compositions and purity levels	Helium or argon used to fill glovebox where cell assembly is carried out and alkali metal is stored. (http://www.airproducts.com/products/gases.aspx)
Do not use nitrogen because it reacts with lithium. Use only helium if sodium is being stored. Purity level needed depends on whether the glovebox is equipped with a water and oxygen removal system. Hydrogen mixtures needed to regenerate water/oxygen removal system, if present or any other suitable gas supplier			