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(54) **LITHIUM-METAL RECHARGEABLE  
ELECTROCHEMICAL CELLS WITH LIQUID  
ELECTROLYTES AND SINGLE-CRYSTAL  
NICKEL-MANGANESE-COBALT**

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#### (57) ABSTRACT

Described herein are lithium-metal rechargeable electrochemical cells comprising positive single-crystal nickel-manganese-cobalt (NMC)-containing structures and liquid electrolytes comprising one or more imide-containing salts, such as bis(trifluoromethanesulfonyl)imide (TFSI<sup>-</sup>)-containing salts, bis(fluorosulfonyl)imide (FSI<sup>-</sup>)-containing salts, and bis(pentafluoroethanesulfonyl)imide (BETI<sup>-</sup>)-containing salts. These salts can also include various cations, such as lithium (Li<sup>+</sup>), potassium (K<sup>+</sup>), sodium (Na<sup>+</sup>), cesium (Cs<sup>+</sup>), n-propyl-n-methylpyrrolidinium (Pyr13<sup>+</sup>), n-octyl-n-methylpyrrolidinium (Pyr18<sup>+</sup>), and 1-methyl-1-pentylpyrrolidinium (Pyr15<sup>+</sup>). For example, imide-containing salts can act as a source of lithium ions in lithium-metal salts. In some examples, the liquid electrolyte further comprises one or more of 1,2-dimethoxyethane (DME), 2,2,2-Trifluoroethyl Ether (TFEE), 1,1,2,2-Tetrafluoroethyl 2,2,3,3-tetrafluoropropyl ether (TFPE), one or more phosphites, and one or more phosphates. In some examples, the liquid electrolyte has a lithium-ion activity of at least 370 mV or even at least about 390 mV (vs. 1M LiFSI in DME at 25° C.). Furthermore, the single-crystal NMC-containing structures can have a nickel concentration of at least 70% atomic.

