Vacuum Deposition and Curing of Liquid Monomers

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Cited US Patents:

Patent Number	Date YYYYMM	Main US Class	Inventor
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Cited non-US Patents:

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GB 1471977	197704		

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Abstract:
The present invention is the formation of solid polymer layers under

vacuum. More specifically, the present invention is the use of "standard" polymer layer-making equipment that is generally used in an atmospheric environment in a vacuum, and degassing the monomer material prior to injection into the vacuum. Additional layers of polymer or metal or oxide may be vacuum deposited onto solid polymer layers.

Formation of polymer layers under a vacuum improves material and surface characteristics, and subsequent quality of bonding to additional layers. Further advantages include use of less to no photoinitiator for curing, faster curing, fewer impurities in the polymer electrolyte, as well as improvement in material properties including no trapped gas resulting in greater density, and reduced monomer wetting angle that facilitates spreading of the monomer and provides a smoother finished surface.

I claim:

1. A method of making a lithium polymer battery, comprising the steps of: a) placing a moving substrate into a vacuum chamber; b) placing a mechanical liquid-monomer spreading apparatus into the vacuum chamber; c) degassing a liquid monomer cathode material; d) depositing a layer of said liquid monomer cathode material onto the moving substrate; e) curing said monomer cathode material forming a solid cathode polymer; and f) depositing and curing a layer of monomer electrolyte material onto said cathode, forming a solid polymer electrolyte with subsequent deposition of lithium metal onto said electrolyte, forming an anode. (Main Claim)
2. The method as recited in claim 1, further comprising the steps of: g) depositing a first monomer insulating material layer onto said moving substrate and curing the first monomer insulating material layer in advance of step (d) deposition of monomer cathode; and h) depositing a cathode current collector metal onto the cured insulating material in advance of step (d) deposition of monomer cathode.
3. The method as recited in claim 2, further comprising the steps of: i) depositing an anode current collector onto the anode; and j) depositing a second monomer insulating layer onto the anode current collector and curing the second monomer insulating layer.
4. A method of making a lithium polymer battery comprising the steps of: a) placing a moving substrate into a vacuum chamber; b) placing a mechanical liquid-monomer spreading apparatus into the vacuum chamber; c) degassing a liquid monomer electrolyte material; d) depositing a layer of lithium metal onto the moving substrate and forming an anode; e) depositing a layer of degassed monomer electrolyte material onto the lithium metal; f) curing said monomer electrolyte material forming a solid electrolyte polymer; and g) depositing and curing a layer of monomer cathode material onto said electrolyte, forming a solid polymer cathode.
5. The method as recited in claim 4, further comprising the steps of: g) depositing a first monomer insulating material layer onto said moving substrate and curing the first monomer insulating material layer in advance of step (d) deposition of lithium metal; and h) depositing an anode current collector metal onto the cured insulating material in advance of step (d) deposition of lithium metal.
6. The method as recited in claim 5, further comprising the steps of: i) depositing a cathode current collector onto the cathode; and j) depositing a second monomer insulating layer onto the cathode current collector and curing the second monomer insulating layer.
7. A method of making electrochromic devices comprising the steps of: a) placing a moving substrate into a vacuum chamber; b) placing a

mechanical liquid-monomer spreading apparatus into the vacuum chamber; c) degassing a liquid monomer electrolyte material; d) depositing a first conductive oxide layer onto the moving substrate; e) depositing a first electrochromic oxide layer onto the first conductive oxide layer; f) depositing the liquid monomer electrolyte material onto the first electrochromic oxide layer; g) curing the liquid monomer electrolyte to a solid polymer electrolyte; h) depositing a second electrochromic oxide layer onto the solid polymer electrolyte; and i) depositing a second conductive oxide layer onto the second electrochromic oxide layer.