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Anodes – Materials Review

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Abstract. In every system for electrochemical energy conversion and storage one of the two electrodes serves as anode. Because this electrode always constitutes upon discharge of a device the negative electrode it is more precisely called this way: negative electrode with the material constituting it called negative mass.

When attempting to somewhat organize the vast field of suitable and of actually utilized materials distinction can be made between systems where electrodes are just the location of the electrode reaction without changing itself as part of this reaction like in a fuel cell or a redox flow battery and systems (both primary and secondary ones) where the active mass is changed in mechanical, structural, morphological and other aspects (like the lead electrode in a lead acid accumulator). In both fields rapid developments are proceeding with some aims and purposes shared by all:

- Materials should be mechanically and chemically stable for a long time and under all operating conditions. This includes capacity of battery/accumulator electrodes and catalytic activity of fuel cell and flow battery electrodes.
- Materials should be cheap and abundantly available.
- Materials should be environmentally acceptable, they should be recyclable.
- Materials used as active masses (and not as electron sinks only) should have electrode potentials as negative as possible.
- Materials should not react with electrolytes (solutions etc.) and further system components.
- Materials should enable electrode reactions proceeding chemically reversibly at sufficiently high rates without substantial structural changes.
- When not in use these desired electrode reactions as well as all other parasitic reactions resulting in loss of stored energy, loss of storage capacity of the active mass and possibly further deterioration of the electrode should proceed at rates as low as possible.

Typical materials for all systems will be briefly addressed, because of the overwhelming interest in electrically rechargeable systems (i.e. accumulators) special attention will be paid to current trends in negative masses used here.