layer of α-alumina fibers of thickness 1 mm ("ICI Ltd. Saffil low density mat") can be arranged between the carbon felt and the solid electrolyte of a flat plate cell. Sudworth and Tilley do not disclose that the α-alumina layer has been fully impregnated with alkali metal polysulfide.

It was an object of the ~~present invention~~embodiments disclosed herein to provide an electrochemical device having solid electrolyte that does not have the disadvantages of the prior art, and that – especially prior to the first charge of the cell – releases less heat in the event of damage to or fracture of the solid electrolyte and hence gives greater safety in the electrochemical cell and ultimately in the entire battery, still with a good internal resistance of the cell.

The object is achieved by the electrode unit as claimed and described herein, also referred to hereinafter as "inventive electrode unit", by the electrochemical device as claimed and described herein, also referred to hereinafter as "inventive electrochemical device", by the process for producing a non-electron-conducting intermediate layer S, as claimed and described herein, by the process for first charging of an electrochemical device, as claimed and described herein, and by the use of a non-electron-conducting intermediate layer S in an electrode unit as claimed and described herein.

In an aspect, there is provided an electrode unit for an electrochemical device, comprising (i) a solid electrolyte which divides a space for molten cathode material, selected from the group consisting of elemental sulfur and polysulfide of the alkali metal anode material, and a space for molten alkali metal anode material and (ii) a porous solid state electrode directly adjacent to the solid electrolyte within the space for the cathode material, with a non-electron-conducting intermediate layer S present between the solid state electrode and the solid electrolyte, wherein this intermediate layer S has a thickness in the range from 0.5 to 5mm and, before the first charge of the electrochemical device, has been impregnated fully with a polysulfide composition, comprising (A) pure polysulfides Met_2S_x with Met = alkali metal of the alkali metal anode material selected from lithium, sodium, potassium, and x is dependent on the alkali metal and is 2, 3, 4 or 5 for Na and is 2, 3, 4, 5, 6, 7, 8 for Li and is 2, 3, 4, 5, 6 for K, or (B) mixtures of the polysulfides of one and the same alkali metal from (A) with one another.

In another aspect, there is provided an electrochemical device comprising the electrode unit as defined in above.

In another aspect, there is provided a process for producing a non-electron-conducting intermediate layer S in an electrode unit as defined above, which comprises subjecting the porous starting material that forms the non-electron-conducting intermediate layer S to a pressure of less than 1 atm and impregnating it with the molten polysulfide composition of the alkali metal that forms the alkali metal anode material comprising (A) pure polysulfides Met_2S_x with Met = alkali metal of the alkali metal anode material selected from lithium, sodium, potassium, and x is dependent on the alkali metal and is 2, 3, 4 or 5 for Na and is 2, 3, 4, 5, 6,

7, 8 for Li and is 2, 3, 4, 5, 6 for K, or (B) mixtures of the polysulfides of one and the same alkali metal from (A) with one another.

In another aspect, there is provided a process for first charging of an electrochemical device as defined above, which comprises initially charging the space for the molten cathode material with a polysulfide compound (I) as a melt, comprising: (A) pure polysulfides Met_2S_x with Met = alkali metal of the desired alkali metal anode material, selected from lithium, sodium, potassium, x is dependent on the alkali metal and is 2, 3, 4 or 5 for Na and is 2, 3, 4, 5, 6, 7, 8 for Li and is 2, 3, 4, 5, 6 for K, or (B) mixtures of the polysulfides of one and the same alkali metal from (A) with one another and/or in each case with elemental sulfur or (C) mixtures of the particular alkali metal sulfide Met_2S with elemental sulfur and/or the polysulfides Met_2S_x mentioned in (A) or (B), and additionally installing, in the space for the molten anode material, an electron-conducting device in such a way that it touches the surface of the solid electrolyte facing the anode material at least in the lower region, connects cathode space and anode space to an electrical circuit and sends an electrical current through this electrochemical device, such that the polysulfide compound (I) is cleaved electrolytically, forming elemental sulfur in the cathode space and metallic alkali metal in the anode space

In another aspect, there is provided the use of a non-electron-conducting intermediate layer S in an electrode unit for an electrochemical device, comprising (i) a solid electrolyte which divides a space for molten cathode material - as defined above - and a space for molten alkali metal anode material, and (ii) a porous solid state electrode which is separated from the solid electrolyte by a non-electron-conducting intermediate layer S, wherein the non-electron-conducting intermediate layer S, before the first charge of the electrochemical device, has been impregnated fully with a polysulfide composition of the alkali metal that forms the alkali metal anode material, comprising (A) pure polysulfides Met_2S_x with Met = alkali metal of the alkali metal anode material selected from lithium, sodium, potassium, x is dependent on the alkali metal and is 2, 3, 4 or 5 for Na and is 2, 3, 4, 5, 6, 7, 8 for Li and is 2, 3, 4, 5, 6 for K, or (B) mixtures of the polysulfides of one and the same alkali metal from (A) with one another.

The inventive electrode unit is within the space for molten cathode material in an electrochemical device, which comprises a space for molten cathode material, selected from the group consisting of elemental sulfur and polysulfide of the alkali metal anode material – this polysulfide preferably as defined hereinafter – and a space for molten alkali metal anode material – the latter preferably as defined hereinafter – which are separated from one another by a solid electrolyte, wherein the electrode unit comprises a porous solid state electrode directly adjacent to the solid electrolyte and a non-electron-conducting intermediate layer S between the solid state electrode and the solid electrolyte, and this intermediate layer S, before the first charge of the electrochemical device, has been impregnated fully with a polysulfide composition of the alkali metal that forms the alkali metal anode material, comprising (A) pure polysulfides Met_2S_x with Met = alkali metal of the alkali metal anode material selected from lithium, sodium, potassium, especially sodium, and x is dependent on the alkali metal and is 2, 3, 4 or 5, preferably 3, 4 or 5, especially 4, for Na and is 2, 3, 4, 5, 6, 7, 8, preferably 3, 4, 5, 6, 7 or 8, for Li and is 2, 3, 4, 5, 6, preferably 3, 4 or 5, especially 5, for K, or (B) mixtures of the polysulfides

of one and the same alkali metal from (A) with one another. This polysulfide composition is also referred to hereinafter as "inventive polysulfide composition".

In this context, "fully" means that virtually exclusively the inventive polysulfide composition is present in the entire open porosity of the starting material that forms the non-electron-conducting intermediate layer S. The open porosity is determined as follows: the bulk density of the starting material that forms the intermediate layer S is determined in a customary manner – for example by determining the weight and the volume. The intrinsic density of the starting material that forms the intermediate layer S is determined in a customary manner or found in the literature, and the open porosity is calculated as follows: 1 – bulk density of the specimen of said starting material/intrinsic density of said starting material that forms the specimen. In