Letter to the Editor

PREPARATION OF SOLID ALKALI METAL ANTHRACENE ADDITION COMPOUNDS AND DETERMINATION OF THEIR ELECTRICAL CONDUCTIVITY

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ПРИГОТОВЛЕНИЕ ТВЕРДЫХ ПРИМЕСНЫХ СОЕДИНЕНИЙ АЛКАЛИЧЕСКОГО АНТРАЦЕНА И ОПРЕДЕЛЕНИЕ ИХ ЭЛЕКТРИЧЕСКОЙ ПРОВОДИМОСТИ

Alkali metal addition compounds of anthracene and various aromatic hydrocarbons, called adducts in the following text, have been known for a long time. They were discovered by led adducts in the following text, have been known for a long time. They were discovered by W. Schlenk [1] in 1914, who was also the first to prepare a solid compound, i.e. Na_2(Atc) (Atc = anthracene). Afterwards much work has been done on solutions of such compounds, especially by ESR-spectroscopy, to elucidate structure and bonding [2], but only in few cases studies have been carried out on isolated crystalline solid compounds. In this context the X-ray studies by E. De Boer [3] and G. D. Stucky [4] should be mentioned. Many solid adducts have been prepared, commonly by evaporating the solvent, but in most cases the substances have a non-stoichiometrical composition (reviewed in [5]). A. R. Ubbelohde [6, 7] was the first to investigate the electrical properties of such adducts of anthracene. According to his data these substances are semi-conductors.

We, for the first time, succeeded in preparing di-metal adducts of anthracene by crystallization from THF/ether solutions at low temperatures down to −70 °C. After filtration and the evacuating of the substances up to room temperature the compounds have the following stoichiometrical composition: Li_2(Atc.) × 4 THF, Na_2(Atc.) × 3 THF, K_2(Atc.) × 2.6 THF.

The substances are dark violet, highly sensitive to air and moisture. Except for the potassium adduct all other adducts are easily soluble in THF. As to electrical conductivity, only the solvent free adducts were expected to show a sufficiently high electron conductivity because of their structure consisting of contact ion pairs. For this reason the solvent free compounds were prepared by heating in vacuo at temperatures of 120 °C, 100 °C and 60 °C, respectively, and the following compounds were obtained: Li_2(Atc.), Na_2(Atc.), K_2(Atc.).

As the substances are extremely sensitive to air, a special cell was constructed, which permits charging at anaerobic conditions and allows to determine the conductivity of powdery substances in dependence on pressure up to 300 MPa (the procedure will be described in a forthcoming paper).

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Contrary to the measurements carried out by Ubbelohde, the specific conductivity shows a marked dependence on presure, not only in the lower range of pressure, but also in the higher one. Starting from powdery substances, there are obviously two ranges in which the gradient of increasing conductivity is different. In the range of up to about 60 MPa the slope is rather high, and at higher pressures the conductivity continues to increase with a linear, but less steep gradient. The sodium adduct shows a much higher conductivity that the corresponding lithium compound. Furthermore, the conductivity rises as the metal content increases. The main results are summarized in table 1.

Table 1

Dependence of the specific conductivity (S/cm) of some adducts on pressure at 25 °C

P MPa Adduct	65	390	0 (released)
$Na_2(Atc)$	0.34×10^{-7}	0.67×10^{-7}	0.12×10^{-7}
$Na_{1,5}(Atc)$	0.02×10^{-7}	0.19×10^{-7}	0.03×10^{-7}
$Li_2(Atc)$	0.19×10^{-9}	0.50×10^{-9}	0.09×10^{-9}

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