

To be, or not to be...Electrochemist? Alexander Kuhn

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FEATURE ARTICLE

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To be, or not to be...Electrochemist?

Alexander Kuhn¹

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11 That is the question we should ask ourselves when addressing 12 the topic of this special issue about "Future tasks of electro-13 chemical research."

14 Even though the Nobel Prize in chemistry has been 15awarded in 2019 for research intimately related to electrochemistry, the word "electrochemistry" is not mentioned a 16single time in the press release of the Royal Swedish 17 Academy of Sciences [1]. Also, the three awardees (John 18 B. Goodenough, M. Stanley Whittingham, and Akira 19Yoshino) would be more considered physicist, chemist, 20and engineer instead of electrochemists. This nicely illus-21trates the current dilemma of electrochemistry, being such 22an interdisciplinary field of research that it is hardly iden-23tified as a discipline by itself. Whether you measure ex-24tremely precisely a very small amount of molecules in the 25brain, or coat a car by metal electrodeposition, electro-26chemistry is everywhere, and the same fundamental con-2728cepts, such as the notion of electron transfer kinetics and potential distribution, are responsible for the observed ef-29fects, even if scales and types of application are completely 30 different! Pushing these thoughts to the extreme would 31lead to a statement similar to the one pronounced very long 32time ago as a welcome address of the Electrochemical 33 Society, claiming that ".... scientific theories point so 3435strongly to the electrical nature of matter and of chemical 36 changes, that we might properly consider that all chemistry 37 is electrochemistry" [2]. Obviously, this is exaggerated, but the truth, and at the same time a trivial statement, is 38that without electrochemistry, our present world would 3940 look completely different. We crucially need electrochemistry in our daily life, and the progress in this field of 41 research over the last decades has contributed in a very 4243considerable way to shape our current society. This has

Univ. Bordeaux, ISM UMR CNRS 5255, Bordeaux INP, ENSCBP, 16 Avenue Pey Berland, 33607 Pessac, France

been well expressed in an editorial in ACS Nano from 44 2016, which states in the very first sentence that "This is 45the golden age of electrochemistry" [3]. I perfectly agree 46 with this sentence in terms of the amount of scientific ac-47 tivities; however, I'm less convinced that this is true when 48 considering this sentence from the viewpoint of electro-49chemistry as a scientific discipline. Electrochemistry, as a 50discipline, has experienced a tremendous loss of visibility. 51Professor positions, which previously were clearly identi-52fied as being in charge of representing the field of electro-53chemistry in a given University, have gradually disap-54peared around the end of the last century and were replaced 55by more fashionable profiles. Many activities, whether 56they are related for example to analytical aspects, energy 57storage/conversion, or materials science, still use the same 58electrochemical concepts and tools, but are no longer iden-59tified as being specific aspects of electrochemistry. The 60 training of our students has experienced a similar tendency. 61 Instead of explicitly advertising the virtues of electrochem-62 istry, courses about this topic are now often diluted in the 63 curriculum and sometimes hidden behind more trendy ti-64 tles. Teaching rather fuzzy notions, like quality manage-65 ment and sustainable development, which obviously might 66 have very tight connections with electrochemistry, will not 67 help to educate future scientists, able to develop brilliant 68 ideas if they don't acquire first an extremely solid scientific 69 know-how, including also the basics of electrochemistry. It 70will rather result in formatted scientists, able to follow and 71obey ISO certifications instead of thinking out of the box. 72The more and more premature specialization of our stu-73dents, rewarding them master's degrees by following 74courses with sexy titles will not lead to the type of broadly 75educated and open-minded scientists that we need for the 76next paradigm changes in science. Most likely, we are 77 partly responsible for this general loss of scientific depth 78and missing visibility of electrochemistry as one of the 79most exciting parts of science of the twenty-first century. 80 When I advertise an open position in my group, I some-81 times avoid using the word "Electrochemistry" (at least in 82

Alexander Kuhn kuhn@enscbp.fr

⁰²

the title), knowing that its popularity among students is
rather limited, and just the name could even scare some
of them.

86 A direct consequence of this lack of identity and absence of 87 clear societal recognition are the problems we encounter when raising funding for fundamental studies in this area of re-88 89 search. As a global tendency, many of us, and this not only concerns electrochemists, are chasing sources of money in-90 stead of pursuing ideas and dreams. It is more and more dif-9192ficult to find financial support for fantasy-driven research in 93 general, and this is even more true for basic aspects of elec-94 trochemistry. Funding agencies and companies, luckily with 95some exceptions, are following a short-term return-oninvestment philosophy, forgetting that all the current success 96 stories in electrochemistry, from batteries to medical devices, 97 have started decades or even centuries ago with some ex-98 tremely fundamental experiments, which, at that time, didn't 99 100have the objective to save the world, but were just designed to 101 better understand certain phenomena. Only research fueled by curiosity and not by the accomplishment of deliverables and 102milestones can lead to real breakthroughs, which eventually 103 will become game changers in a more or less close future. 104

105Therefore, our three biggest tasks for the future of electrochemical research are to fight for adequate funding of funda-106mental studies, to defend or eventually restore a solid and 107 108well-identified electrochemical training of students instead of the increasingly spreading of diluted and superficial pseudo 109knowledge, and to conquer a better social visibility and rec-110 111 ognition as a discipline. The latter aspect is also far from 112obvious, because it is much easier to fascinate the general public with galaxies, the behavior of animals, or sociological 113114studies, than with the properties of nanoelectrodes. This

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means that we have to invest more time and effort for making 115 electrochemistry more popular. 116

In conclusion, we are facing quite some challenges for the 117next decade or so, but there is light at the end of the tunnel. In 118 recent years, at least in some countries, centers of excellence 119 in electrochemistry have emerged and have been funded, ac-120companied by adequate professor positions; some students 121 start to understand, eventually only after having left the uni-122versity that the basic notions of electrochemistry can be very 123helpful in their scientific life; a young and dynamic generation 124of scientist is currently rising, which seems to be proud of 125being electrochemists, [4] and hopefully will come up with 126plenty of fresh ideas and concepts. 127

So, let's make electrochemistry great again!!

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