J. Condensed Matter Nucl. Sci. 31 (2020) 42–48

Research Article

A Tale of Two Journals

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Abstract

Earlier we discussed the flawed journal review process and how it stifles innovation and the diffusion of knowledge. Recently we tried to publish a paper describing our LENR experiences working with undergraduate chemical engineering students in an education journal. One journal had a word limit for articles as well as a fairly rigid format which prevented us from telling the story the way we wanted to. Although we addressed all the issues of the reviewers, the paper was rejected, after ten months and multiple revisions, on the grounds *that independent research projects were outside the scope of the journal*. We eventually published the paper in another education journal. In this journal, we were able to tell the narrative the way we originally wanted to, all the while emphasizing the advantages of involving students in verifying new scientific phenomena. This paper describes the events that transpired.

Keywords: Mentoring, Review process, Undergraduate projects

1. Introduction

As members of the Low Energy Nuclear Reactions/Condensed Matter Nuclear Science (LENR/CMNS) community continue to age and retire, the question has been posed how to reverse this process. Clearly the answer is to engage younger people and some members of the community have had some success. Before his passing in 2016, John Dash of Portland State University had mentored a number of high school/undergraduate/graduate students. These students had done calorimetry of the Pd/D and Ti/D system and had analyzed their cathodes using SEM-EDX. From their measurements they not only saw excess heat but evidence of the transmutation of Pd to Ag [1,2]. Both George Miley, University of Illinois, and Peter Hagelstein, MIT, have been the advisors of graduate students who have conducted research on LENR-related projects. Miley et al. [3] developed thin film electrodes that gave both excess heat and emitted charged particles as well as low-intensity X-rays. Hagelstein [4] has primarily been involved in developing

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theories/models to explain LENR. More recently his group has been investigating the non-exponential decay of X-ray and γ lines from Co-57 on steel plates [5]. Fran Tanzella and Mike McKubre of SRI International have had undergraduate interns conduct LENR experiments. Most notably one of their Stanford University interns, Ben Earle, had conducted Pd/D co-deposition experiments with CR-39 detectors. However, in his early experiments using Fukuvi CR-39, Earle had deviated from the original protocol [6] and had left the 60 μm thick polyethylene covers on the surface of the detectors. Rather than terminate the experiments, it was decided to allow them to run to completion. The detectors were etched and *still showed tracks*. The polyethylene covers had protected the CR-39 from both chemical and mechanical damage providing further evidence that the pits observed on the detectors were nuclear in nature. These detectors were subjected to extensive analysis by groups from SPAWAR, NASA, and the Russian Academy of Sciences. From these analyses it was determined that the tracks observed in the CR-39 detectors were due to $\geq$3 MeV protons, $\geq$1.8 MeV alphas, and secondary particles due to recoils from either energetic protons and/or neutrons [7,8].

Our own group has also had some success in mentoring students. We had approached chemistry professors at the University of California, San Diego (UCSD) asking them if they would be willing to replicate our results of track formation in solid state nuclear track detectors used in Pd/D co-deposition. It happened that the Chemical Engineering Process Laboratory I and II classes at the UCSD were required for senior undergraduate students. In these classes, the students work in groups of four. In Laboratory I, projects in the areas of applied chemical research and unit operations are conducted. As indicated in the curriculum:

> *The emphasis of this class is the application of engineering concepts and fundamentals to solve practical and research problems. In Laboratory II, the students plan research projects in the areas of applied chemical technology and engineering operations. Each group executes the experimental work and articulates (both orally and in written form) the research plan and results. Students are given the opportunity to propose, design, and test new ideas and experimental procedures and to work with researchers from other facilities.*

Consequently, given the scope of these classes, our Pd/D co-deposition experiment was considered to be a good candidate for a group of students to execute. Between 2007 and 2010, three different groups of senior undergraduate students in the chemical engineering department of UCSD conducted Pd/D co-deposition experiments as part of their independent research projects. Specifically, they replicated the experiments using CR-39 detectors to detect the emission of energetic particles. Controls and simulations were done by the students to rule out a chemical explanation for the tracks. In these efforts, we provided the students with chemicals, a protocol, and copies of pertinent publications. In turn, the students conducted the experiments independently of us and achieved positive results.

While these efforts to engage with younger future scientists are commendable, we need to reach out to an even greater number of students, scientists, and professors. To this end, we decided to publish our experiences with the chemical engineering undergraduate students in an educational journal with the hope that this would provide a broader audience for the field. In this communication we discuss what transpired. What we experienced was reminiscent of what we discussed in our earlier paper describing the flawed journal review process [9]. This is despite the protocol being granted a US Patent, 8,419,919, "System and Method for Generating Particles", in 2013. The protocol has been replicated in laboratories and facilities in five countries over 200 times resulting in 59 peer reviewed papers by 2017.

2. Journal of Chemical Education

The first journal we approached was the ACS Journal of Chemical Education. According to the journal's web site [10], the journal publishes papers on laboratory experiments "that have been successfully used with students to investigate chemical phenomena as well as to develop skills with laboratory techniques, equipment, or instrumentation." Much earlier Stan Szpak, the inventor of the co-deposition process, had indicated that a colleague of his had previously used this journal to gain acceptance of some unconventional ideas. Szpak did try to publish a paper on Pd/D co-deposition in this journal only to be told that the journal did not publish science research papers unless they had a direct link to the teaching and learning of chemistry. Since we had directly worked with undergraduate students, we thought this journal would be a good vehicle for our purpose which was to gain wider acceptance of LENR or, at the very least, to stimulate interest.

We submitted our first version of the paper, 'Use of Pd/D co-deposition to Generate Energetic Particles,' on January 30, 2016. In this first version of the paper, we simply presented what was required of the students in their research project. We then described the experiments that were done by the students and the results they obtained. Specifically, the students learned how to do electroplating. They did an electroplating experiment using $PdCl_2$ and LiCl in D_2O. Cyclic voltammetry [11,12] and galvanostatic pulsing experiments [13] had shown that, as the Pd plated out, an ever-expanding electrode surface was created that assured non-steady state conditions and local high D loading in the lattice (D/Pd ratio $\geq$1). A suitable control would be to electroplate a metal that did not absorb deuterium into its lattice. As their control, the students used a solution of $CuCl_2$ and LiCl in D_2O for another electroplating experiment. When they used the $PdCl_2$–LiCl–D_2O plating solution, the students saw tracks in the CR-39 detector. However, when they used the $CuCl_2$–LiCl–D_2O plating solution, no tracks were observed in the CR-39 detector.

On February 2, 2016, the journal withdrew the submission. We were told that before the manuscript could be sent for review, we had a few issues that needed to be resolved and we were advised to review their guidelines and to use their template. From both the guidelines and the template, it became clear we had to be more specific as to what the students would learn after conducting their experiments. The keywords had to include the categories of audience (educational level of a student), domain (general area of study or interest within chemistry), pedagogy (describes an aid to learning or an instructional approach), and topic (indicates with greater specificity than Domain an area within chemistry). Within these categories were drop down lists to choose from. Upon reflection, we decided the main learning objective for the students was the importance of controls as part of the scientific method. The paper was rewritten emphasizing this. On February 16, 2016 we resubmitted the paper, now titled 'Energetic Particle Emission in Pd/D co-deposition: The Importance of Controls,' to the journal. On March 9, 2016, the paper passed internal review and was assigned to an editor who sent it out for assessment by three reviewers.

On May 1, 2016, we received the reviewer reports. The recommendations ranged from 'minor revision' to 'do not publish.' One reviewer thought that the project was well designed and met highest standards for scientific and scholarly rigor. Another reviewer, when asked 'If articles were published in order of value to readers, when should this one appear?,'said 'Never.' The editor's decision was:

> *On the basis of the reviewers appraisals and my own careful study of your manuscript, I have decided that your manuscript is not suitable for publication in the Journal of Chemical Education in its present form. However, your research has some positive components. I would consider a thoroughly rewritten manuscript, with substantial modification, incorporating the reviewers points and including any additional data they recommended.*

As this was an encouraging response from the editor, we revised the manuscript taking into account the reviewer comments. The reviewer comments and our responses are shown *vide infra*.

One reviewer asked 'How many readers would actually consider doing this experiment or even just distribute the article to teach about controls?' In our response, we indicated that this was an independent research project. In science, unexpected results occur and it is only through control experiments that they are verified as being correct and that this was as good an experiment as any to demonstrate this. We further said that science is supposed to be thought provoking and to encourage independent thinking as only then can advances be made. Clearly this experiment falls in that category. This same reviewer questioned the validity of using $CuCl_2$ electroplating as a control. In the paper we stated that a suitable control experiment would be to plate out a metal that does not absorb deuterium. No tracks were observed in the Cu/D co-deposition experiment which led to the conclusion, by the students, that the tracks were not due to chemical/mechanical damage. The reviewer said that does not prove it at all, it just proves copper acts differently than palladium. We disagreed with the reviewer on this statement. All the electrochemical reaction products are the same (dendritic metal plates out; D_2, O_2, and Cl_2 gases form; OD^- forms at the cathode). This was stated in the original text. These are the only chemical species that are available to attack the detector. The only difference is that Pd absorbs D and Cu does not. Pd/D gives tracks, Cu/D does not. Consequently, the tracks formed in the detector used in the Pd/D co-deposition experiment could not be due to chemical damage nor could they be due to mechanical damage caused by the metal dendrites. The reviewer also said the students could/should do more control experiments to raise the level of confidence that the tracks are not the result of chemical/mechanical damage or to radioactive contamination and that this would be a great class project. In our response, we agreed with the reviewer that the students could do more control experiments. To address this, we added a table to the revised paper which summarized additional control experiments that had been done and what the results were [6]. We further suggested, in the revised manuscript, that these control experiments could be a class project that could result in thought-provoking discussions as to the origins of the tracks observed in the Pd/D experiments. To further increase the confidence that the tracks were nuclear in origin, we included track modeling using TRACK-TEST, a free downloadable program developed by Nikezic and Yu [14,15]. TRACK-TEST allows one to estimate the energy of the particle that entered the detector as well as the angle of incidence. The calculated results obtained using TRACK-TEST match with the measured features of the imaged track (shape as well as minor and major axes).

The reviewers complained about the length of the experiment. We pointed out that, for an independent research project, it is acceptable for experiments to last more than a week. There were questions about reproducibility. In our response to the reviewer we indicated that we would never have given an experiment for students to do if it was not reproducible. We then modified the paper to say:

> *Formation of tracks in CR-39 detectors used in Pd/D co-deposition experiments has been extremely reproducible. However, control experiments need to be done to show that the tracks are not due to either radioactive contamination or mechanical/chemical damage.*

There were other questions on hazards and safety. We were instructed to provide stronger language regarding the use of fume hoods. We complied by saying that the cell should be placed in a well ventilated area, *i.e.* a fume hood, as D_2, O_2 and Cl_2 gases are generated. Also the potentiostat/constant current power source should be grounded. They also wanted to know if there were any concerns about the emission of high energy particles. We indicated that linear energy transfer (LET) analysis indicated that the solution and cell components will moderate the charged particles and that they will not escape the cell. The rate of particle production was on the order of 1 particle/s. Also the NRC limits on public exposure to radiation is 2 mrem/h and we were orders of magnitude below that.

The revised manuscript was submitted on September 14, 2016. On November 30, 2016, the editor rejected the manuscript saying:

> *The reviewers have expressed serious reservations about this work that I do not believe could be addressed through a standard major revision. In light of the comments received, I am unable to accept the manuscript for publication. A key concern is whether this has actually been run as part of an undergraduate laboratory with typical student results (as is required by the journal for publication). Independent research projects are outside the scope of this journal.*

Throughout the process we had indicated that we were describing an independent research project conducted at a university by senior undergraduate students. Only now did the editor and reviewers indicate, after ten months of review and multiple revisions of the manuscript, that independent research projects were outside the scope of the journal. This was disingenuous. The reviewers acknowledged that we had addressed their earlier concerns in the revised manuscript yet they still had reservations and did not, or refused to, accept our explanations One reviewer went so far as to say that we had to 'make the case that the underlying science is not crackpot.' Another reviewer complained that there was the assumption that readers would be familiar with Pd/D co-deposition. This was an unfair comment as we did define co-deposition and provided references. We could not go in-depth into co-deposition as the journal had a 6000 word limit for articles.

Our experience with the Journal of Chemical Education was disappointing. For the most part, the editor had treated us fairly. We were, however, constrained by the journal's word limit and how they wanted the article to be organized, which was not the way we wanted to tell our story. We wanted to explain how it was we were able to connect with the students. But given the rigid format of the journal, we were unable to do so. Also, of the four reviewers, two clearly were never going to allow the manuscript to be published in the journal. There was nothing we could have done to have persuaded them otherwise. Undeterred, we began to search for another journal to publish our narrative.

3. Journal of Laboratory Chemical Education

In June 2017 we saw that the Journal of Laboratory Chemical Education had a call for papers for a special issue on Chemistry Laboratory in Graduation Projects. The scope of the special issue was:

> *All undergraduate students have the requirement of completing a graduation project as part of their graduation. The purpose of the graduation projects is to provide students with an opportunity to progress in the strengthening of knowledge and skills acquired throughout their years in the educational system. These graduation projects can be considered as pilot projects on topics related to real problems. The aim of this Special Issue is to offer laboratory experiences that can be used as basis of graduation projects.*

We contacted the editor of the special issue to see if the journal would consider a submission from us. We told the editor how it came about that the undergraduate students did a replication of our Pd/D co-deposition experiment using CR-39 detectors. We acknowledged that the area of research was controversial. However, we had published our results in peer-reviewed journals. We indicated that two necessary requirements to achieve acceptance in the scientific community of a new phenomenon are replications and reproducibility, which was one of the lessons learned by the students. Furthermore, having students involved in replications could result in a new paradigm for scientists to obtain verification of their work. We also sent the editor the abstract for a paper that was now entitled 'Energetic Particle Emission in Pd/D co-deposition: Using Undergraduate Research Projects to Verify New Scientific Phenomena.' On June 15, 2017 the editor responded with:

> *The data and the experience that you have collected during some years, with undergraduate students in a scientific area with some controversy, can provide challenging insight into the understanding of the scientific method. Therefore, according to the guidelines of the Special Edition, I invite you to send me the manuscript.*

As there was no word limit, we rewrote the Journal of Chemical Education paper taking into account the comments of the reviewers of the original manuscript. The journal also allowed us to include, as supplementary material, a write-up of the protocol used by the students. On July 6, 2017, we submitted our manuscript for the special issue. A few weeks later, we got a positive reviewer's report and the paper was accepted. The special issue on Chemistry Laboratory in Graduation Projects was published in June 2018 [16]. In the introduction for the special issue the editor wrote:

> *A number of research groups have contributed to this Special Issue of the Journal of Laboratory Chemical Education, 2018. In total, nine papers have been compiled covering various aspects of the Chemistry laboratory experience which can be used as a basis for designing undergraduate projects. These papers exhibit all aspects of proper scientific methodology: revision of available literature on the specific topic, replication of published data, hypothesis testing, verification of experimental procedures with literature, acquisition of experimental data, and even development of some basic instrumentation tailored to meet the specific demands of the project.*

The paper by Mosier-Boss highlights the importance of replication in science by analyzing the track formation in solid state nuclear detectors. The project described here extended over several years and was carried out by different groups at different levels. The subject area is not entirely free from controversy, but rather than this being a reason to shun the topic, it can be seized upon to offer an opportunity to gain insight into the scientific method by seeing it in action. The experiments illustrate the importance of replication of results reported in the literature as a means of quality control within the framework of scientific methodology, especially in the case of unexpected or anomalous results.

One year after the paper appeared in the Open Access Journal and had been posted to academia.edu and researchgate.net sites, it had been viewed or downloaded over 2000 times. This indicates to us that, despite the comments/concerns of the reviewers for the original paper submitted to the Journal of Chemical Education, there is interest in the field.

4. Conclusions

All we wanted to do was to tell our experience having undergraduate chemical engineering students do our LENR-related experiment. It was very rewarding working with young people who had no recollection of the events that had transpired in 1989. We, as well as the students, benefitted from the experience. For us, it counted as a replication and introduced younger, future professionals to the field. For the students, they got an opportunity to see how the scientific process worked and the importance of controls/simulations in verifying new phenomena. They also learned about metal electroplating, Faradaic efficiency, solid state nuclear track detectors, and modeling. Our attempt to publish our story in one journal was met with disdain by two out of four reviewers and showed that, even after almost 30 years, the phenomenon was still widely not accepted. Despite what others in the LENR/CMNS field believe, we still have to convince the scientific community that nuclear reactions can occur in metal lattices once the appropriate conditions are achieved. Furthermore, the burden of proof is upon us. We did eventually find a journal that allowed us to tell our story the way we wanted to.

We would like to point out that there are many advantages to using undergraduate students to verify new scientific phenomena. For the most part they do not have pre-conceived ideas and are open to new concepts. Nor do they have reputations or funding to protect. Last year we were contacted by an adjunct professor at Point Loma Nazarene University (PLNU). One of her students was interested in plasmas and fusion experiments. After a literature search he had found our papers and wanted to do some experiments for his honor's project. The professor then asked for our help. We gave her the protocol that had been published in 2018. We also provided them with CR-39 detectors and met periodically to see how they were progressing. They have also successfully replicated the Pd/D and Cu/D co-deposition experiments. Currently they are conducting additional control experiments that were suggested in the published protocol [16].

5. Epilogue

One of the UCSD undergraduate teams had a poster session at an international Conference in Italy [17] and two years later they gave an invited talk to the American Chemical Society national Meeting in Salt Lake City, Utah that was published separately [18]. The PLNU undergraduate had a poster session at the American Physics Society national meeting in Boston in 2019 [19]. Recently, he has submitted a paper to an undergraduate physics journal, where he is experiencing some of the same bias we had.

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