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October 30, 2026

To: IEEE History Committee

Subject: Expert Review Report for IEEE Milestone Proposal: Carbon Nanotubes, 1991

Dear Members of the IEEE History Committee,

Below is my expert review report for the IEEE Milestone Proposal on Carbon Nanotubes, 1991, evaluated from the perspective of nanomaterials research.

(1) Is suggested wording of the Plaque Citation accurate?

Answer: Yes, with a minor suggestion for clarification.
The proposed citation appropriately summarizes the historical significance of the discovery. As described in the proposal's appendix, the 1991 carbon samples (cathode deposits from fullerene production) were prepared using Prof. Yoshinori Ando's arc-discharge apparatus at Meijo University, whereas the nanotube structures were identified by high-resolution transmission electron microscopy (HRTEM) at NEC. Given this distinction between sample preparation and structural identification, the wording "using the arc-discharge method at Meijo University" is somewhat ambiguous regarding the respective roles of Meijo University and NEC Corporation, as well as its applicability to both the 1991 and 1993 discoveries. It may be worth considering a more specific expression, such as "in arc-discharge carbon, including 1991 samples from Meijo University," to help clarify the historical circumstances.

(2) Is evidence presented in the proposal of sufficient substance and accuracy to support the Plaque Citation?

Answer: Yes.
The proposal presents strong historical and technical evidence within the Historical Significance and supporting documentation sections. In particular, the primary literature

cited, Sumio Iijima's seminal 1991 paper published in Nature (Vol. 354, pp. 56–58), entitled "Helical microtubules of graphitic carbon", demonstrates the concentric cylindrical structure of multi-walled carbon nanotubes through high-resolution transmission electron microscopy (HRTEM). The subsequent 1993 Nature paper by Iijima and Ichihashi presents experimental evidence for single-walled carbon nanotubes. These findings establish a solid scientific basis for the proposed IEEE Milestone.

(3) Does proposed milestone represent a significant technical achievement?

Answer: Yes.
As detailed in the Historical Significance section, the discoveries of multi-walled carbon nanotubes in 1991 and single-walled carbon nanotubes in 1993 represent a major achievement in materials science and nanotechnology. They established an important foundation for the study of one-dimensional nanomaterials with unique structural and electronic properties. In particular, the dependence of electronic properties on nanotube diameter and chirality opened new opportunities for nanoscale electronic devices. This achievement has stimulated extensive research and technological developments in nanoelectronics, including carbon nanotube transistors and other nanoscale devices.

(4) Were there similar or competing achievements? If so, have the proposers adequately described these and their relationship to the achievement being proposed?

Answer: Yes.
The proposal adequately addresses the historical context of carbon filament and graphitic carbon observations prior to 1991 in the Features Setting This Work Apart from Similar Achievements section. The proposers appropriately discuss earlier studies of carbon fibers and related carbon nanostructures, including the pioneering work of Endo and colleagues. The proposal also explains how Iijima's detailed structural characterization in 1991 differed from these earlier studies and contributed to establishing carbon nanotubes as an important field of research.

(5) Have proposers shown a clear benefit to humanity?

Answer: Yes.
Carbon nanotubes have contributed to technological advances with broad and lasting benefits to humanity. As highlighted in the proposal, their unique electrical and mechanical properties have enabled their use in high-performance composite materials and as conductive additives for energy storage devices, particularly lithium-ion batteries. Furthermore, carbon nanotube research has contributed to the development of low-dimensional materials science, which also includes research on two-dimensional materials such as graphene and transition metal dichalcogenides.

(6) Are the supporting reference texts credible? Are there reference texts which ought to have been included in support of the proposal, but which are missing?

Answer: Yes.
The supporting references are credible and include important primary research articles documenting the discovery and subsequent development of carbon nanotubes. In particular, the inclusion of the original 1991 Nature article by S. Iijima provides strong scientific support for the proposed milestone. However, minor bibliographic corrections are needed. The volume number of the 1991 Nature paper [1] should be corrected from 345 to 354, and the page range of the 1993 Nature paper [6] should be corrected from 503–605 to 603–605. In addition, the URL in reference [16], attributed to Yano Research Institute, incorrectly links to Straits Research and should be corrected.

(7) If personal name(s) in the plaque citation, has proposer(s) demonstrated unassailably that the criteria for name inclusion in criteria have been met?

Answer: Yes.
Based on the evidence presented in the Justification for Name-in-Citation section and the criteria outlined in Section 6 of the IEEE Milestones Guidelines, the inclusion of Sumio Iijima's name is justified. His 1991 single-author Nature paper documents his central role in the discovery and structural identification of multi-walled carbon nanotubes. This contribution had a significant and lasting impact on the development of carbon nanotube research and nanoelectronics.

Conclusion

The discovery of carbon nanotubes represents a foundational scientific and technological achievement of exceptional importance in modern science and engineering. It helped initiate the modern era of nanoscale materials research and continues to inspire breakthroughs across materials science, electronics, and energy applications. Therefore, I strongly recommend this proposal for approval as an IEEE Milestone.

Yours sincerely,



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