



Sept. 10, 2020

**Association of Asia-Pacific Physical Societies (AAPPS)  
Division of Plasma Physics (AAPPS-DPP)**

## **AAPPS-DPP Plasma Innovation Prize**

– Professor Masaru Hori is selected as Second Laureate –

The Division of Plasma Physics (Chair: Mitsuru Kikuchi) under the Association of Asia Pacific Physical Societies (President: Jun'ichi Yokoyama) selected Professor **Masaru Hori** of Nagoya University as the second Laureates of AAPPS-DPP Plasma Innovation Prize, which is awarded to scientists who have made seminal / pioneering contributions in the field of plasma applications, focusing on impacts on industry. He is the first Laureate from Japan.

### Citations

*Masaru Hori: "For his outstanding contributions to diverse range of applied and fundamental plasma science and technology using low-temperature plasmas, in particular, for the carbon film mask technology development for plasma etching for semiconductor manufacturing technologies; for invention and commercialization of ultra-compact atomic radicals measurement equipment and high-density radical source for radical controlled plasma processing and synthesis for functionalized materials; and for discoveries related to the use of plasma activated medium/lactic in plasma medicine for selective killing of various cancer cells."*

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## On the achievements of Professor Masaru Hori



**Prof. Masaru Hori**

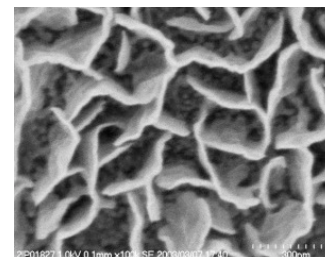
Prof. Masaru Hori was born in Gifu, Japan, in 1958, received his Ph. D at Nagoya University in 1986. After working at Toshiba Corporation ULSI laboratory from 1986 to 1992, he returned to Nagoya University. Since 2004, he has been Professor of the Nagoya University. Now, he is a Director of Center for Low-temperature Plasma Sciences in Nagoya University.

Prof. Masaru Hori has accomplished 6 big inventions for plasma process innovations. Firstly, he invented the **carbon film as a mask material for plasma etching in the semiconductor manufacturing** at 1992. This technology has become an essential technology for the current CMOS device manufacturing, and it is no exaggeration to say that AI and 5G could not be

realized without this technology.

Secondly, he invented an **ultracompact atomic radicals (H, O, N, C, F) measurement equipment** with vacuum ultraviolet absorption spectroscopy. By using this equipment, he measured absolute densities of H, O, N, C and F atoms for the first time in the reactive plasma processes. He succeeded in elucidating their reactions mechanisms, and made numerous groundbreaking innovative discoveries, opening the field of "**Radical-controlled plasma processing**" ahead of the world.

Thirdly, Dr. Hori and Dr. Hiramatsu invented a novel method of **Carbon Nanowalls (CNWs)** with a radical injection plasma chemical vapor deposition (CVD) without any catalyst for the first time in 2004. Their patents of 28 registrations with 62 applications on the CNWs. Their inventions opened a new avenue in CNWs technologies and industries.

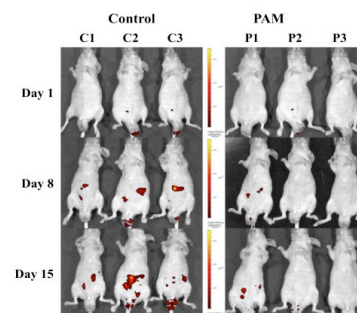


**Carbon Nanowall**

Fourthly, he is the inventor of **High-Density Radical Source (HRDS)** with a guarantee of the absolute radical density applied for GaN epitaxial growth in MBE and discovered the high rate growths of GaN and InGaN films with a high quality at low temperatures in MBE.

Fifthly, in 2006, he invented the **ultrahigh electron density ( $\sim 5 \times 10^{16} \text{cm}^{-3}$ ) low temperature atmospheric pressure plasma source** of which concept is extremely new and the density is the top record in the world. He found out that it enabled to get the extremely strong adhesion among materials, which were applied to automobile industries and furthermore opened a new bio field.

Finally, in 2012, Dr. Hori and his colleagues discovered for the first time in the world that the plasma activated medium can kill ovarian cancer cells with a very high selectivity to normal cells and named PAM. He is the inventor of the **plasma activated medium (PAM) and plasma activated lactic (PAL), which can selectively kill various cancer cells**, such as ovarian, brain and stomach / pancreatic cancers and so on. Dr. Hori systematized results towards the establishment of plasma medical science by publishing a book of Plasma Medical Science (2018). His papers of 50 regarding the plasma medicine and the number of paper citations is 1718 (2020, 3/02) only for 6 years are extremely excellent and epoch-making. All of inventions above towards the plasma process innovations were developed by Prof. Hori's great scientific results and supported by his patents of **Registered Patent: 171 (Patent Applications: 393)**.



**Therapeutic effect of PAM administration on peritoneal mice with gastric cancer**

His great achievements are summarized as follows, Prof. Hori has 546 papers, 3,020 presentations including 1,802 international conferences with 618 invited talks, 29 books, and 24 awards in his lifetime achievements. Over 30 years, he has been an outstanding plasma scientist putting his heart into the progress of low-temperature plasma region from both viewpoints of sciences and industries. It is consistent in his strong earnest to achieve the establishment of reactive plasma process sciences including semiconductor, material processes and plasma life fields and his performances on both of sciences and innovations are evaluated to be extremely excellent with high originality in many fields.



## Appendix-1: 2020 AAPPS-DPP Plasma Innovation Prize

AAPPS-DPP Plasma Innovation Prize was founded by the AAPPS-DPP in 2019. This prize is given to a plasma physicist/engineer annually to recognize outstanding contributions to experimental and/or theoretical research in all fields of plasma applications, focusing on impacts on industry. The 2020 Selection Committee composed of leading physicists of plasma application in Asia-Pacific region.

Selection committee:

Chairman:

Prof. Rajdeep S. Rawat (Nanyang Technological University)

Members:

Prof. Masaharu Shiratani (Kyushu University)

Dr. Masaru Izawa (Hitachi High-Tech Science Corporation)

Prof. Roderick W. Boswell (Australian National University)

Dr. Anthony B Murphy (CSIRO)

Prof. Chao Chang (Xi'an Jiaotong University)

Prof. XinPei Lu (HuaZhong University of Science and Technology)

Prof. M. Krishnamurthy (Tata Institute of Fundamental Research)

Prof. Sudeep Bhattacharjee (India Inst. of Technology)

Prof. Hyyong Suk (Gwangju Institute of Science and Technology)

Prof. Wonho Choe (Korea Advanced Institute of Science and Technology)

Prof. Paul K. Chu (City University of Hong Kong)



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20 August 2020

Professor Mitsuru Kikuchi  
Chairman and CEO, AAPPS-DPP

AAPPS-DPP Plasma Innovation Prize 2020

Dear Professor Kikuchi,

I have great pleasure in conveying to you the decision of the Selection Committee regarding the AAPPS-DPP Plasma Innovation Prize 2020.

The Selection Committee recommends that the **AAPPS-DPP Plasma Innovation Prize for the year 2020 be awarded to Professor Masaru Hori** from Nagoya University, Japan.

The proposed award citation for the awardee is as follows:

Masaru Hori: "For his outstanding contributions to diverse range of applied and fundamental plasma science and technology using low-temperature plasmas, in particular, for the carbon film mask technology development for plasma etching for semiconductor manufacturing technologies; for invention and commercialization of ultra-compact atomic radicals measurement equipment and high-density radical source for radical controlled plasma processing and synthesis for functionalized materials; and for discoveries related to the use of plasma activated medium/lactic in plasma medicine for selective killing of various cancer cells."

Yours sincerely

Professor Rajdeep Singh Rawat  
Chair,  
Selection Committee of AAPPS-DPP Plasma Innovation Prize 2020

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## AAPPS-DPP Innovation Prize

is awarded by Division of Plasma Physics, AAPPS  
for outstanding contribution to the field of Plasma Application.  
This Diploma certifies that 2020 Prize has been awarded to

**Masaru Hori**

For his outstanding contributions to diverse range of applied and fundamental plasma science and technology using low-temperature plasmas, in particular, for the carbon film mask technology development for plasma etching for semiconductor manufacturing technologies; for invention and commercialization of ultra-compact atomic radicals measurement equipment and high-density radical source for radical controlled plasma processing and synthesis for functionalized materials; and for discoveries related to the use of plasma activated medium/lactic in plasma medicine for selective killing of various cancer cells



M. Kikuchi  
Mitsuru Kikuchi  
Chair of DPP

Rajdeep Singh RAWAT  
Chair of Selection  
Committee

26 October, 2020

Division of Plasma Physics, AAPPS

Certificate, medal and cash prize will be given at the 4<sup>th</sup> Asia-Pacific Conference on Plasma Physics in Oct.26, 2020.