

April 24, 2024

Mitsubishi Corporation

Denka Company Limited

**MC and Denka Sign J/V Agreement in Fullerene Business  
Aim to Promote Initiatives in Thin-film Solar Cells and Other Organic Electronics**

Mitsubishi Corporation (MC) and Denka Company Limited (Denka) are pleased to announce our signing of a joint-venture agreement in the business of fullerenes, carbon molecules that form the base of cutting-edge materials in the field of nanotechnology. Under the terms of our agreement, Denka shall acquire from MC a 50% stake in Frontier Carbon Corporation (FCC), a company dedicated to the manufacturing and sales of fullerenes.

Fullerenes are nanoscale allotropes of carbon, whose single or double-bonded atoms are joined together in hexagonal rings in spherical form, similar in appearance to a soccer ball. They have excellent conductive and thermal properties and can be dissolved in common organic solvents at room temperature, which makes them effective conductors in organic, thin-film solar cells.<sup>1</sup> Research is also underway into their application as an electron transporting layer in perovskite solar cells<sup>2</sup>, which are garnering attention as next-generation photovoltaic technology. Use as smartphone sensors and other new possibilities are indicative of strong growth potential in the field of fullerenes.

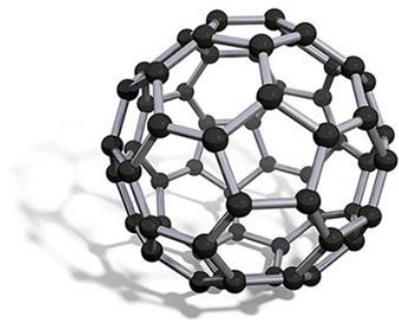
Since establishing FCC in 2001, MC has leveraged tech-based collaborations with longstanding customers, built a sales network, and otherwise made strong inroads into the commercial-use fullerene market. Having acquired a substance<sup>3</sup> and other fullerene related patents, MC is committed to applying its multi-industry collective capabilities towards FCC's future growth and development.

Energy transformations are a key part of MC's latest management plan, "Midterm Corporate Strategy 2024,"<sup>4</sup> which demonstrates the company's aim to help industries decarbonize by connecting their needs with seeds of growth in materials and other areas. Offering fullerene-based solutions is just one of the ways that MC is playing its part to realize a carbon-neutral society.

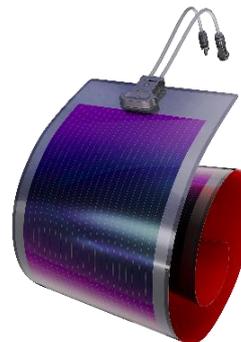
Denka has strengths that will prove invaluable in supporting FCC's future growth, including the carbon-nano-material expertise and manufacturing technologies that the former has built up through its mass production of acetylene black<sup>5</sup>, a highly conductive carbon material used in high-voltage cables and lithium-ion batteries. Denka will play an equally important role in supporting the construction of business infrastructure by taking advantage of its manufacturing-facility and other utilities. These assets promise to enhance the company's presence in the carbon nanomaterials market and further its business expansion plans in this field.

Recognizing that the industrial potential of fullerenes spans their use in electronics, biopharmaceuticals, and many other industries, Denka also has plans to incorporate them into its operations in ICT & Energy, Healthcare, and Sustainable Living, the three focal fields of its latest management plan, "Mission 2030"<sup>6</sup>.

MC and Denka look forward to combining our respective expertise in sales and technology to promote the growth of fullerene applications. Our shared goal is to leverage FCC's operations to address societal challenges by developing systems to boost production and meet the growing demand for these cutting-edge materials.



Basic fullerene (C60) structure



Organic, fullerene-based thin-film solar cell

1. Photovoltaic cells that use a thin film of organic semiconductors as the power-generating layer. There are two types of semiconductor materials (p-type and n-type), with fullerene being an n-type material.
2. Photovoltaic cells made from materials with a perovskite crystal structure, coated with a liquid form and baked on a thin glass or plastic substrate.
3. Fullerene substance patent: A basic patent for fullerenes in the US, covering the manufacture and sale of fullerenes (including products using fullerenes). (Patent number US7,494,638B1/US8,101,149B1)
4. [https://www.mitsubishicorp.com/jp/ja/about/plan/pdf/mcs2024\\_220510.pdf](https://www.mitsubishicorp.com/jp/ja/about/plan/pdf/mcs2024_220510.pdf)
5. A type of carbon black produced by the thermal decomposition of acetylene. The batteries and cables made with acetylene black are used in EVs and offshore wind power generation.
6. Eight-year management plan covering fiscal years 2023 to 2030.  
[https://www.denka.co.jp/eng/storage/news/pdf/423/20221108\\_denka\\_vision\\_mission2030\\_materials\\_en.pdf](https://www.denka.co.jp/eng/storage/news/pdf/423/20221108_denka_vision_mission2030_materials_en.pdf)

#### Frontier Carbon Corporation (as of April 24, 2024)

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|-----------------------|---|
| (1) Company name:     | Frontier Carbon Corporation                                       |
| (2) CEO:              | Koichi Oshima   |
| (3) Established:      | 2001  |
| (4) Head office:      | 2-1 Kanda-Nishikicho 2-chome, Chiyoda-ku, Tokyo                   |
| (5) Investment ratio: | Mitsubishi Corporation 50%, Denka 50%                             |
| (6) Business:         | Manufacture and sale of fullerenes and fullerene-applied products |

#### Inquiry Recipients

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