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Fluid dynamic analog experiments on “Pele’s hair” using a handmade cotton candy machine

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On the south flank of Kilauea volcano in Hawaii Island, we will find glass fibers called “Pele’s hair” in the volcanic products of lava fountains and explosions. It is named after Pele, who is the Hawaiian goddess of volcanos. “Pele’s hairs” are highly stretched volcanic glass products, which are formed by breakup, stretching, and cooling of molten magma during their eruption. The texture of the glass fibers (thickness and length of fibers) depend on many parameters such as rheological properties of the volcanic glass, cooling rate, ejection speed, wind velocity, and so on. In order to consider the formation process of “Pele’s hair” in classroom experiments, we developed a handmade cotton candy maker. We used a commercial stirrer which could control the rotating speed. At the edge of the stirrer, we attached a rotating dish, which was made of thin steel and had small outlets along its periphery. To make fibers of sugars (threads of cotton candy), crystal sugar (“Za-ra-me” in Japanese, coarse sugar) was added to the dish and rotated at a constant speed. The melted sugar was formed after heating the rotating disk and ejected through the outlets. We measured the temperature of the melted sugar by a commercial radiation thermometer and the flow behavior of the melted sugar jet was captured by a high-speed video camera, which helped us to understand the formation process. By controlling the rotating speed, heating temperature and diameter of the outlets, we have succeeded in producing a variety of analog “Pele’s hair” and Pele’s tear”. We carefully examined the texture of the analogue Pele’s products and discussed the role of these controlling parameters on their formation process. In this presentation, we will also discuss the similarity of the texture of Pele’s hairs, which were sampled from volcanic products in Hawaii Islands, with the analog Pele’s hairs of cotton candy using a commercial digital microscope.