

# Research of Polymeric Origami-based Tube

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## Abstract

Miura was the first to propose a new pseudo-cylindrical concave polyhedral tube with origami in 1969. With its excellent mechanical property and high lightweight performance, the tube has a broad prospect in engineering applications, such as energy absorber and beam in automotive field, stent in medical domain, shelter in architecture field and inflatable boom in space. Currently, most researches focus on geometrical design and kinematic mechanism analysis, such as geometrical design and parameterization, rigid-foldable design, and flat foldability. The researchers pay more attention to fold angles, edge angles and unit parameters which are usually selected and used as the geometrical parameters and are used to calculate zero-thickness geometric modifications. However, it is not suitable to be used for the actual fabrication that the angle geometrical parameters are difficult to obtain and measure. Besides, it is difficult to be fabricated because of these origami structures with large curvature and complex local fluctuations, which restricts its development and application.

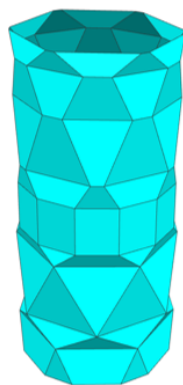


Fig.1 Geometrical structure of Origami-based tube

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The aims of this research are to fabricate of polymer Origami-based tube with high quality and efficiency. Firstly, a novel cylindrical Origami-based tube with the corrugated surface composed of trapezoids is proposed as shown in Fig.1. Such tube depends on the basic geometrical parameters which involve lengths and gradients instead of those angles for the manufacturing. Then, several Origami-based tubes formed by different kinds of trapezoids are present. According to geometry features of the tube, a forming method used for fabricating the Origami-based tube is proposed. Based on this method, a theory expressed by five geometrical parameters is established to describe the area forming draw ratio from cylindrical tube to Origami-based tube in the actual manufacturing. Then, the feasibility of fabrication but not foldability of the Origami-based tube is researched.

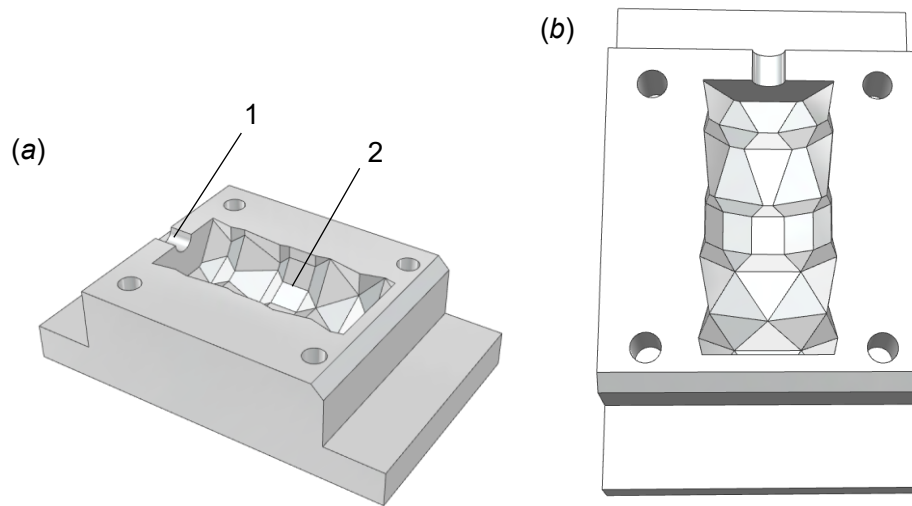


Fig.2 Mold structure of Origami-based tube. (a) 3D view (1. Air hole, 2. Cavity.), (b) top view.

Finally, a blow forming mold applied to form the Origami-based tube is designed as shown in Fig.2, and corresponding mold and polymer Origami-based tube are fabricated. This research provides a guidance for a method to fabricate Origami-based tube structure with high efficiency and quality.