- Żurek W, Kopias K. Struktura płaskich wyrobów włókienniczych. Ed. WNT, Warsaw, 1983, p. 272.
- Dalidovicz AS. Osnowy teori wiazania. Ed. Liogkaja Industria, Moscow, 1970, p. 432.
- Mikołajczyk Z. Identification of the process of knitting of the warp-knitted anisotropic structures on warp-knitting machines (in Polish), Scientific Letters TUL 2009, Nr 1047, Dissertation z. 381, p. 234.
- Helbig F. New dimensions for functional, regular 3D knitting. *Melliand English* 2006; 10: 153-155.
- Helbig F. Geometrische Elemente regulärer 3D-Gewirke. *Melliand Textilberichte* 2007; 3: 124-127.
- Zhang L-Z, Jiang G-M, Miao X-H, Cong H-L. Three-dimensional Computer Simulation of Warp Knitted Spacer Fabric. *Fibres & Textiles in Eastern Europe* 2012; 20, 3(92): 56-60.
- Kowalski K, Włodarczyk B. Modification of External Layers of Distance Knitted Fabrics with Elastomeric Threads and Its Effect on the Structural Parameters. *Fibres & Textiles in Eastern Europe* 2012; 20, 4(93): 62-66.
- Mikołajczyk Z, Pieklak K, Golczyk A, Wiater Z. Spatial knitted product, patent application from 12.09.2008, P – 386074.
- Mikołajczyk Z, Pieklak K, Golczyk A, Wiater Z. Spatial warp-knitted product, patent application from 12.09.2008, P – 386075.
- Pieklak K, Mikołajczyk Z. New Generation of Structures in Warp-Knitted Distance Fabrics. In: *AUTEX International Conference 2009*, 26 – 28 May 2009, CESME – Turkey.
- Mikołajczyk Z, Pieklak K. Innovative Structures and Technology of Spatial Warp-Knitted Fabrics. In: 45th International Federation of Knitting Technologists IFKT, 27 – 29 May 2010, Ljubljana, Slovenia.
- Neue Software für dreidimensionale Legungsdarstellung und – simulation. *Melliand Textilberichte* 2008; 11-12: 456 – 457.
- 14. Kyosev Y, Rahjens A, Renkens W. How clear is the boundary between reality and simulation? – Virtual and real warpknitted – a comparative study between 3D simulation and actual fabrics. *Kettenwirk-Praxis* 2009; 4: 40 – 42.
- ProCad warpknit Version 5- more than just 3D cinema for product developers

 A new generation of software for simulating textiles in product development. *Kettenwirk-Praxis* 2010; 4: 34 – 35.
- Pieklak K, Mikołajczyk Z. Architecture Designing of Warp-Knitted Fabrics. In: XV Scientific Conference of the Faculty of Material Technologies and Textile Design at the Lodz University of Technology, Łódź, 2012, p. 4.

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