

NONLINEAR ELLIPTIC EQUATIONS WITH SMALL *BMO* COEFFICIENTS IN NONSMOOTH DOMAINS IN GENERALIZED MORREY SPACES

T. S. GADJIEV* AND V. S. GULIYEV

Abstract. We obtain the generalized Sobolev-Morrey spaces $W_{p,\varphi}^1(\Omega)$ estimate for weak solutions of a boundary value problem for nonlinear elliptic equations with *BMO* coefficients in nonsmooth domains. We investigate regularity of the weak solutions in generalized Morrey spaces $M_{p,\varphi}(\Omega)$. The nonlinearity has sufficiently small *BMO* seminorm and the boundary of the domain is sufficiently flat.

Mathematics subject classification (2020): 35J25, 35B40, 42B20, 42B25.

Keywords and phrases: Nonlinear elliptic equations, generalized Sobolev-Morrey spaces, maximal function, Reifenberg flat domain, small *BMO*.

REFERENCES

- [1] A. AKBULUT, V. S. GULIYEV, R. MUSTAFAYEV, *On the boundedness of the maximal operator and singular integral operators in generalized Morrey spaces*, Math. Bohem. 137 (1) 2012, 27–43.
- [2] P. AUSCHER, M. QAFQANU, *Observations on $W^{1,p}$ estimates for divergence elliptic equations with VMO coefficients*, Boll. Unione Mat. Ital. Sez. B Artic. Ric. Mat. (8) 5(2) (2002), 487–509.
- [3] V. BURENKO, A. GOGATISHVILI, V. S. GULIYEV, R. MUSTAFAYEV, *Boundedness of the fractional maximal operator in local Morrey-type spaces*, Complex Var. Elliptic Equ. 55 (8–10) (2010), 739–758.
- [4] S. BYUN, L. WANG, *Elliptic equations with *BMO* coefficients in Reifenberg domain*, Comm. Pure Appl. Math. 57 (10) (2004), 1283–1310.
- [5] S. BYUN, L. WANG, *Parabolic equations in time dependent Reifenberg domains*, Adv. Math. 212 (2) (2007), 797–818.
- [6] S. BYUN, L. WANG, S. ZHOU, *Nonlinear elliptic equations with *BMO* coefficients in Reifenberg domain*, J. Funct. Anal. 250 (1) (2007), 167–196.
- [7] L. A. CAFFARELLI, *Interior a priori estimates for solutions of fully nonlinear equations*, Ann. of Math. 130 (2) (1989), 189–213.
- [8] F. CHIARENZA, M. FRASCA, P. LONGO, *$W_{2,p}$ -solvability of Dirichlet problem for nondivergence elliptic equations with VMO coefficients*, Trans. Amer. Math. Soc. 336 (1993), 841–853.
- [9] E. DI BENEDETTO, J. MANFREDI, *On the higher integrability on the gradient of weak solutions of certain degenerate elliptic system*, Amer. J. Math. 115 (5) (1993), 1107–1134.
- [10] Y. DING, D. YANG, Z. ZHOU, *Boundedness of sublinear operators and commutators on $L^{p,w}(\mathbb{R}^n)$* , Yokohama Math. J. 46 (1) (1998), 15–27.
- [11] G. DI FAZIO, *L^p estimates for divergence form elliptic equations with discontinuous coefficients*, Boll. Unione Mat. Ital. A (7) 10 (2) (1996), 409–420.
- [12] G. DI FAZIO, D. I. HAKIM, Y. SAWANO, *Elliptic equations with discontinuous coefficients in generalized Morrey spaces*, Eur. J. Math. 3 (3) (2017), 728–762.
- [13] T. S. GADJIEV, SH. GALANDAROVA, V. S. GULIYEV, *Regularity in generalized Morrey spaces of solutions to higher order nondivergence elliptic equations with VMO coefficients*, Electron. J. Qual. Theory Differ. Equ. Paper No. 55 (2019), 17 pp.
- [14] T. S. GADJIEV, V. S. GULIYEV, K. G. SULEYMANOVA, *The Dirichlet problem for the uniformly elliptic equation in generalized weighted Morrey spaces*, Studia Sci. Math. Hungar. 57 (1) (2020), 68–90.

- [15] V. S. GULIYEV, *Integral operators on function spaces on the homogeneous groups and on domains in \mathbb{G}* , Doctor's degree dissertation, Moscow, Mat. Inst. Steklov, 1994, 1–329, (Russian).
- [16] V. S. GULIYEV, *Function spaces, integral operators and two weighted inequalities on homogeneous groups. Some applications*, Baku. 1999, 1–332, (Russian).
- [17] V. S. GULIYEV, *Boundedness of the maximal, potential and singular operators in the generalized Morrey spaces*, J. Inequal. Appl. Art. ID 503948, (2009), 20 pp.
- [18] V. S. GULIYEV, S. S. ALIYEV, T. KARAMAN, P. SHUKUROV, *Boundedness of sublinear operators and commutators on generalized Morrey spaces*, Integral Equations Operator Theory, 71 (3), (2011), 1–29.
- [19] V. S. GULIYEV, T. S. GADJIEV, SH. GALANDAROVA, *On solvability Dirichlet problem for higher order elliptic equation*, Electron. J. Qual. Theory Differ. Equ., Paper No. 71 (2017), 17 pp.
- [20] V. S. GULIYEV, T. S. GADJIEV, A. SERBETCI, *The Dirichlet problem for the uniformly higher-order elliptic equations in generalized weighted Sobolev-Morrey spaces*, Nonlinear Studies, 26 (4) (2019), 831–842.
- [21] V. S. GULIYEV, L. SOFTOVA, *Global regularity in generalized Morrey spaces of solutions to nondivergence elliptic equations with VMO coefficients*, Potential Anal. 38 (3) (2013), 843–862.
- [22] V. S. GULIYEV, L. SOFTOVA, *Generalized Morrey estimates for the gradient of divergence form parabolic operators with discontinuous coefficients*, J. Differential Equations 259 (6) (2015), 2368–2387.
- [23] V. S. GULIYEV, M. N. OMAROVA, L. SOFTOVA, *The Dirichlet problem in a class of generalized weighted Morrey spaces*, Proc. Inst. Math. Mech. Natl. Acad. Sci. Azerb. 45 (2) (2019), 270–285.
- [24] P. HAJLASZ, O. MARTIO, *Traces of Sobolev functions on fractal type sets and characterization of extension domains*, J. Funct. Anal. 143 (1) (1997), 221–246.
- [25] J. KINNUNEN, S. ZHOU, *A local estimate for nonlinear equations with discontinuous coefficients*, Comm. Partial Differential Equations 24 (11–12) (1999), 2043–2068.
- [26] J. KINNUNEN, S. ZHOU, *A boundary estimates for nonlinear equations with discontinuous coefficients*, Differential Integral Equations 14 (4) (2001), 475–492.
- [27] C. B. MORREY, *On the solutions of quasilinear elliptic partial differential equations*, Trans. Amer. Math. Soc. Soc. 43 (1) (1938), 126–166.
- [28] T. MIZUHARA, *Boundedness of some classical operators on generalized Morrey spaces*, Harmonic Anal. Proc. Conf. Sendai/Jap. 1990, ICM-90 Satell. Conf. Proc., 183–189.
- [29] J. PEETRE, *On the theory L_p* , J. Func. Anal. 4 (1969), 71–87.
- [30] E. NAKAI, *Hardy-Littlewood maximal operator, singular integral operators and the Reisz potentials on generalized Morrey spaces*, Math. Nachr. 166 (1994), 95–103.
- [31] E. NAKAI, *Orlicz-Morrey spaces and the Hardy-Littlewood maximal function*, Studia Math. 188 (3) (2008), 193–221.
- [32] S. NAKAMURA, Y. SAWANO AND H. TANAKA, *The fractional operators on weighted Morrey spaces*, J. Geom. Anal. 28 (2) (2018), 1502–1524.
- [33] D. PALAGACHEV, L. RECKE, L. SOFTOVA, *Applications of the differential calculus to nonlinear elliptic operators with discontinuous coefficients*, Math. Ann. 336 (3) (2006), 617–637.
- [34] Y. SAWANO, *Generalized Morrey spaces for non-doubling measures*, Nonlinear Differential Equations Appl. 15 (4–5) (2008), 413–425.
- [35] Y. SAWANO, *A thought on generalized Morrey spaces*, ArXiv preprint arXiv:1812.08394v1, 2018, 78 pp.
- [36] L. SOFTOVA, *Singular integrals and commutators in generalized Morrey spaces*, Acta Math. Sin. (Engl. Ser.) 22 (2006), 757–766.
- [37] L. SOFTOVA, *Singular integral operators in Morrey spaces and interior regularity of solutions to systems of linear PDE's*, J. Global Optim. 40 (1–3) (2008), 427–442.
- [38] T. TORO, *Doubling and flatness: geometry of measures*, Notices Amer. Math. Soc. 44 (9) (1997), 1087–1094.
- [39] E. REIFENBERG, *Solutions of the Plateau problem for m -dimensional surfaces of varying topological type*, Acta Math. 104 (1960), 1–92.